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OFFICE OF WATER RESEARCH AND TECHNOLOGY

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VOLUME 13, NUMBERS 22, 23, & 24
DECEMBER 15, 1980

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SELECTED WATER RESOURCES ABSTRACTS

A semimonthly publication of the
Office of Water Research and Technology
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The Secretary of the U.S. Department of the Interior has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1983.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most our our nationally owned-public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographic citation and a set of identifiers or descriptors which are listed in the **Water Resources Thesaurus.** Each abstract entry is classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

WRSIC IS NOT IN A POSITION TO PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Office of Water Research and Technology.

To provide SWRA with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas.

The input from these Centers, and from the 54 Water Resources Research Institutes administered under the Water Research and Development Act of 1978, as well as input from the grantees and contractors of the Office of Water Research and Technology and other Federal water resource agencies becomes the information base from which this journal is derived.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

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01 NATURE OF WATER

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03 WATER SUPPLY AUGMENTATION AND CONSERVATION

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04 WATER QUANTITY MANAGEMENT AND CONTROL

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05 WATER QUALITY MANAGEMENT AND PROTECTION

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07 RESOURCES DATA

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ABSTRACT SOURCES

SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

WATER REVISITED,
Bell Labs., Murray Hill, NJ.
F. H. Stillinger.
Science, Vol 209, No 4455, p 451-457, July 25, 1980. 8 Fig, 40 Ref.

Descriptors: *Water properties, *Hydrogen bonding, *Water structure, Bonding, Water, Molecular structure, Temperature, Water temperature, Melting, Water chemistry, Supercooled water, Molecules.

Liquid water consists of a macroscopically connected, random network of hydrogen bonds, with frequent strained and broken bonds, that is continually undergoing topological reformation. Anomalous properties of water rise from the competition between relatively bulky ways of connecting molecules into local patterns characterized by strong bonds and nearly tetrahedral angles and more compact arrangements characterized by more strain and bond breakage. However, these alternatives constitute virtually a continuum of architectural possibilities rather than a discrete pair of options. The singular behavior of supercooled water near -45C and the 'hydrophobic' of relatively strain-free convex cages or polyhedra. (Sims-ISWS)
W80-06492

BIAS EVALUATION OF THE CATION-EXCHANGE METHOD FOR SULFATE AND CHLORIDE,
Wisconsin Univ. Madison. Water Chemistry Lab.
R. E. Stauffer.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 8, p 1266-1275, August 1980. 1 Fig, 10 Tab, 26 Ref.

Descriptors: *Cation exchange, *Water analysis, *Thermal water, Water chemistry, Sulfates, Chlorides, Water quality, Analytical techniques, Analysis, Methodology, Mathematical models, Data collections, Fluorides.

The coefficient of variation for sulfate determinations = 1% at the 50 mg/L level. In the absence of sulfate, the chloride conductance response curve is linear for (0 less than Cl less than 100 mg/L). The sulfate response curve is mildly nonlinear, being, however, adequately modeled using log K sub 1 (SO4(2-)) = 1.97 (25 C), where K sub 1 is the proton association constant. The temperature-dependent solubility product K sub sp (AgCl) affects the blank correction for unbiased SO4 estimates. The bicarbonate conductance effect is effectively modeled using log K sub 1 (HCO3(-)) = 6.35 (25 C). The fluoride effect is adequately modeled using log K sub 1 (F(-)) = 3.18 (25 C) for aqueous mixtures of chloride, sulfate, and fluoride. In applying the cation-exchange method to sulfate analyses of alkaline high-Cl, high-F, geothermal waters, positively biased sulfate estimates were obtained; the bias depended on the SO4/F equivalence ratio and on the dilution level (of the natural water), and probably resulted from pH-dependent HF complexing with Si02 or B(OH)3, both constituents being notably high in geothermal waters. Analytical strategies were discussed allowing procedural optimization for many natural waters. (Humphreys-ISWS)
W80-06611

PHERE. 1. OXYGEN,
Amherst Coll., MA. Dept. of Physics.
B. B. Benson, and D. Krause, Jr.
Limnology and Oceanography, Vol 25, No 4, p 662-671, July 1980. 1 Fig, 3 Tab, 23 Ref.

Descriptors: *Dissolved oxygen, *Isotope fractionation, *Freshwater, *Solubility, Mathematical models, Water properties, Theoretical analysis, Analytical techniques, Data collections, Analysis, Oxygen, Gases.

Equations and tables were presented from which accurate values can be obtained, in any of several sets of units, for the concentration of oxygen dissolved in freshwater in equilibrium with the atmosphere from 0 C to 40 C and 0.5 to 1.1 atm. They are based on values for the Henry coefficient of oxygen, k sub o, which have an estimated accuracy of 0.02%. Equations were derived which relate k sub o to equilibrium concentrations in natural waters. The equations include corrections for molecular interactions in the vapor phase. Uncertainty about the best way to correct for these interactions limits the estimated accuracy of the derived values to about + or - 0.07% at 0 C and 0.04% at 40 C, but the new results are much more accurate than values from the UNESCO tables. Within their random errors, previous measurements agree very well with the new results. Under equilibrium conditions, and between 0 C and 60 C, the per mil difference between the 3402:3202 abundance ratio in the dissolved gas and the air is given by delta = -0.730 + (427/T), where T is in kelvin and the standard deviation is less than 0.02%. (Humphreys-ISWS)
W80-06627

2. WATER CYCLE

2A. General

ADAPTIVE REAL-TIME FORECAST OF RIVER FLOW-RATES FROM RAINFALL DATA,
Centro Teoria dei Sistemi, Milan (Italy). Ist. di Elettrotecnica ed Elettronica.
P. Bolzern, M. Ferrario, and G. Fronza.
Journal of Hydrology, Vol 47, No 3/4, p 251-267, July 1980. 4 Fig, 1 Tab, 28 Ref, 1 Append.

Descriptors: *Rainfall, *Runoff, *River flow, *Model studies, Mathematical models, Forecasting, Streamflow, Rivers, Lakes, Drainage, Watersheds(Basins), Floods, *Rainfall-runoff relationships, Hydrology.

This paper described a stochastic rainfall-river flow-rate model of the ARMAX type. A real-time Kalman predictor was derived from the model, namely, a recursive relationship which, at the beginning of each time step, supplies the 'best' forecast of future flow-rate on the basis of current rainfall and flow-rate measurements. Three different versions (ordered in the sense of increasing complexity) of the predictor were considered, corresponding to different approaches for estimating parameters and noise statistics of the stochastic model. The flood forecast performance of all predictors was tested on a real case (Lake Maggiore water system). The performance was satisfactory (for instance correlations about 99% between forecast and true values, standard deviation of the forecast error less than 1% of the average flood flow-rate), and conspicuously better than the one given by the trivial persistence predictor (the future flow-rate is the present one). (Sims-ISWS)
W80-06472

DAILY FLOW MODEL BASED ON RAINFALL OCCURRENCES USING PULSES AND A TRANSFER FUNCTION,
Birmingham Univ. (England). Dept. of Civil Engineering.
N. T. Kottegoda, and M. A. Horder.
Journal of Hydrology, Vol 47, No 3/4, p 215-234, July 1980. 10 Fig, 3 Tab, 8 Ref.

Descriptors: *Rainfall, *Runoff, *Model studies, Mathematical models, Drainage, Watersheds(Basins), Flow, Streamflow, *Rainfall-runoff relationships, Rivers, River flow, Hydrology.

A probability model was formulated for the process of daily rainfall by considering the occurrence of wet and dry days. The relationship between rainfall and runoff was then examined, from which a rainfall-runoff model was derived using pulses and a transfer function. Relationships between model parameters and catchment characteristics were also investigated. The model was extended to the multisite case through the evaluation of joint probabilities of rainfall runs at more than one site. (Sims-ISWS)
W80-06473

RAINFALL INTERCEPTION BY A BEECH-PODOCARP-HARDWOOD FOREST NEAR REEFTON, NORTH WESTLAND, NEW ZEALAND,
Forest Research Inst., Christchurch (New Zealand).
L. K. Rowe.
Journal of Hydrology (New Zealand), Vol 18, No 2, p 63-72, 1979. 2 Fig, 4 Tab, 14 Ref.

Descriptors: *Interception, *Forest watersheds, *Stemflow, Watersheds(Basins), On-site investigations, Foreign countries, Foreign research, Hardwood, Data collections, Water loss, Canopy, Forests, Rainfall, Throughfall, Evaporation, *New Zealand.

A rainfall interception study was made of a beech-podocarp-hardwood forest near Reefton, New Zealand, during the 3-year period 1 October 1975 to 30 September 1978. Throughfall for the period was 4540 mm, 73% of the 6220 mm gross rainfall. Seasonal variation was evident, mean throughfall for the summer months (October to March) and the winter months (April to September) being 68% and 77% of their respective gross rainfalls. Stemflow was measured for only 2 years and amounted to 1.5% of the gross rainfall. Interception loss averaged 26% for the whole period, 30% in summer and 21% in winter. Interception storage capacity was estimated to be of the order of 2 mm. (See also W79-06418) (Humphreys-ISWS)
W80-06475

FLOW ESTIMATION IN AN UNSTABLE RIVER ILLUSTRATED ON THE RAKAIA RIVER FOR THE PERIOD 1958-1978,
Ministry of Works and Development, Christchurch (New Zealand). Water and Soil Science Centre.
R. P. Ibbitt.
Journal of Hydrology (New Zealand), Vol 18, No 2, p 88-108, 1979. 10 Fig, 3 Tab, 10 Ref.

Descriptors: *Watersheds(Basins), *Rating curves, *River flow, *Natural streams, Alluvial channels, Estimating, Analytical techniques, Analysis, Streamflow forecasting, Rainfall, Discharge(Water), Channel erosion, River beds, Hydrographs, Movement, Water levels, Statistical methods, Data collections, On-site investigations, Foreign research, Foreign countries, Hydrology, *New Zealand, *Rakaia River(New Zealand).

The application of improved data-checking techniques to the hydrological data for the Rakaia River at the Gorge bridge station, New Zealand, was described. Inadequacies in the existing data were demonstrated. Use of computer techniques to display gaging data allowed rating change points to be identified. By grouping together consistent sets of gagings a single type curve was developed. All ratings were obtained by moving the type curve parallel to the water level axis. In this way, small groups of gagings can be used to fix the position of a rating. Where there were no gaging data, rating changes were based on differences in the water level hydrograph recession levels. To validate these rating changes the annual flows calculated using them were compared with annual means from one other flow station and seven rainfall stations. High correlations were established with West Coast rainfall stations, and a more detailed check of the flow data was made using the Hokitika rainfall record. The accuracy of the flow values calculated using the new ratings was assessed, and the 95% confidence limits were shown to vary between plus or minus 3% and plus or minus 11%. The upper limit is associated with three months of record where there were no gaging data and obvious silting problems in the water level record. As a consequence of the work, the long-term mean flow value was reduced by 5%. (Humphreys-ISWS)
W80-06477

CLUTHA FLOOD OF OCTOBER 1978,

Ministry of Works and Development, Wellington (New Zealand). Power Div.
I. G. Jowett.
Journal of Hydrology (New Zealand), Vol 18, No 2, p 121-140, 1979. 9 Fig, 6 Tab, 6 Ref.

Descriptors: *Floods, *Rivers, *Sediment discharge, *Peak discharge, Watersheds(Basins), Foreign countries, Foreign research, Data collections, Runoff, Sediments, Rainfall, Probable maximum precipitation, Hydrographs, Design flood, Model studies, Analysis, Flood flow, Rating curves, *New Zealand, *Clutha River(New Zealand).

Flows in the Clutha catchment, New Zealand, during the October 1978 flood have been analyzed, and peak discharges were presented. Flood volumes were compared with rainfall for this and all earlier major floods. A flood prediction model, capable of accurately predicting flood hydrographs at the lakes and at Roxburgh from rainfall data, could be incorporated into a flood warning system. This storm was compared with the estimated probable maximum, and it was shown that the efficiency of the October 1978 storm was equal to the highest previously recorded. The quantity of sediment deposited in Lake Roxburgh by this single flood was almost equal to two-thirds of the average amount transported annually. Three sets of sediment data were presented and comparisons made between them. Unless suspended sediment concentrations are assumed to have an upper limit of 12,000 ppm, the sediment volumes predicted using sediment concentration vs. flow rating curves considerably exceed the volumes measured in Lake Roxburgh by both siltation survey and daily suspended sediment sampling. Of the 2.90 Mt deposited in the lake over the seven months, about 1.0 Mt was deposited in the October flood. (Humphreys-ISWS)
W80-06479

THE NUMERICAL CALCULATION OF EXTREME WET AND DRY PERIODS IN HYDROLOGICAL TIME SERIES,
Technical Univ. of Istanbul (Turkey). Dept. of Hydraulics and Water Power.
Z. Sen.
Hydrological Sciences Bulletin, Vol 25, No 2, p 135-142, June 1980. 4 Fig, 1 Tab, 5 Ref.

Descriptors: *Hydrological data, *Markov processes, *Droughts, *Wet seasons, *Statistical methods, Data processing, Time series analysis, Monte Carlo method, Hydrology, Analytical techniques, Analysis, Mathematical models, Methodology, Numerical analysis, Probability.

A numerical method for evaluating the possibilities of the extreme wet and the extreme dry periods of a hydrological sequence was presented on the basis of stationary independent and Markovian processes that are currently employed in the planning and operation of water resources systems. The validity of the formula was checked against the Monte Carlo simulation results obtained on a digital computer. Recurrence relationships for the probability distribution functions of the longest wet and dry periods were derived by direct enumeration and the statistical properties of these extremes were presented. (Humphreys-ISWS)
W80-06481

SHIFTING LEVEL MODELLING OF HYDROLOGIC SERIES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. D. Salas, and D. C. Boes.
Advances in Water Resources, Vol 3, No 2, p 59-63, June 1980. 4 Fig, 30 Ref. NSF ENG77-26729.

Descriptors: *Hydrology, *Mathematical models, *Statistical methods, *Time series analysis, Hydrologic systems, Hydrologic data, Stochastic processes, Analytical techniques, Analysis, Data processing, Streamflow, Synthetic hydrology, *Shifting level models, Autoregressive models, Fractional Gaussian model, Broken line model.

The potential of applying shifting level (SL) models to hydrologic processes was discussed in light of observed statistical characteristics of hydrologic data. An SL model and an ARMA (1,1) model were fitted to an actual hydrologic series. Computer simulation experiments with these models were carried out to compare maximum accumulated deficit and run properties. Results obtained indicate that the mean maximum accumulated deficit, mean longest negative run length, and mean largest negative run sum for both models are similar while there are differences in their corresponding variances. (Lee-ISWS)
W80-06486

WATER RESOURCES OF THE JUDITH BASIN, CENTRAL MONTANA,
Montana Bureau of Mines and Geology, Billings.
R. D. Feltis.
Montana Bureau of Mines and Geology Hydrogeologic Map 1, 1980. 3 Sheets, 12 Ref.

Descriptors: *Groundwater resources, *Hydrogeology, *Water quality, *Montana, *Groundwater recharge, Surface runoff, Precipitation(Atmospheric), Aquifer characteristics, Water supply, Domestic water, Irrigation, Streamflow, Low flow, Chemical analysis, Hydrologic data, Maps, Hydrographs, *Judith River basin(MT), *Central Montana.

The surface-water and ground-water resources of the basin are closely interrelated. Nearly all the water is from precipitation within the basin and surrounding mountains. Surface runoff is an important source of water for recharge of several artesian sandstone and limestone aquifers that extend beneath the basin. Some of the aquifers are used extensively for domestic and stock water supply. The first-magnitude springs (discharge greater than 100 cu ft/sec) derive water from a cavernous artesian limestone aquifer, the Madison Group of Early and Late Mississippian age. This aquifer is a potential source of water for large-scale agricultural or industrial use. Development of the limestone aquifer may offer water users a unique opportunity to manage a surface-water ground-water system in a manner that is beneficial to a large area. The U.S. Geological Survey and the Montana Bureau of Mines and Geology began a cooperative program of ground-water studies in 1955 to provide data for planning the use and conservation of the groundwater resources of the State. The purpose of this atlas is to make available to the public the hydrologic data that were compiled during three studies of the water resources of the western and southern, eastern, and northern parts of the Judith Basin. The atlas contains some data not included in the water-resources studies. (USGS)
W80-06533

PROCEEDINGS OF THE MILITARY HYDROLOGY WORKSHOP, 17-19 MAY 1978, VICKSBURG, MISSISSIPPI.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A069404, Price codes: A06 in paper copy, A01 in microfiche. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi Technical Report EL-79-2, May 1979. 116 p.

Descriptors: *Hydrology, *Military aspects, Streamflow, Soil moisture, Water supply, Flood waves, Meteorology, Groundwater, *Workshop proceedings.

A Military Hydrology Workshop cosponsored by the U. S. Army Research Office and the U. S. Army Engineer Waterways Experiment Station (WES) was held at WES on 17-19 May 1978. The purpose of the workshop was to formulate military hydrology research needs. Hydrologic experts representing various Federal, State, and private agencies were in attendance. Technical papers concerning various aspects of hydrology were presented during general sessions. Working groups were then formed to address four specific areas of hydrology: (1) streamflow, (2) soil moisture, (3) meteorology, and (4) water supply. Each group developed a research plan which identified short-term capability update requirements and long-term technology advancement requirements. Synopses of the research plans were presented during the final general session. (WES)
W80-06548

A MATHEMATICAL MODEL FOR ESTIMATING PESTICIDE LOSSES IN RUNOFF,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W80-06616

APPLICATION OF THE USDAHL-74 HYDROLOGY MODEL TO GRASSLAND WATERSHEDS,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
F. R. Crow, T. Ghermazien, and R. L. Bengtson.
Transactions of the American Society of Agricultural Engineers, Vol 23, No 2, p 373-378, March-April 1980. 7 Fig, 7 Tab, 9 Ref.

Descriptors: *Runoff, *Rainfall-runoff relationships, *Watersheds(Basins), *Model studies, Mathematical models, Evaluation, Calibrations, Grasslands, Land use, Water balance, Evaporation, Topography, Hydrology, Oklahoma, *USDAHL-74 Model, Grassland watersheds.

The USDAHL-74 Model of Watershed Hydrology was evaluated on three grassland watersheds in north-central Oklahoma. Watershed W-3 (37 ha) was the base watershed for a 6-yr calibration period and an 18-yr test period. The land use parameter values obtained by the W-3 calibration were also used for a 21-yr test on watershed W-4 (83 ha) and a one-year test on environmental research watershed ENV (55 ha). The average runoff error for the 18 yr period was 12% under prediction. (Sims-ISWS)
W80-06675

UNSTEADY DRAWDOWN IN 2-D WATER TABLE AQUIFER,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
D. T. Higgins.
Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol 106, No IR3, Proceedings Paper 15696, p 237-251, September 1980. 5 Fig, 4 Tab, 4 Ref, 2 Append.

Descriptors: *Drawdown, *Aquifers, *Water table, *Model studies, Mathematical models, Hydraulic models, Flumes, Unsteady flow, Drainage, Irrigation, Groundwater, Groundwater movement, Hydraulic transients, Hydrology, *Drainage engineering.

The inclusion of vertical velocity effects results in integral solutions to the linearized problem of instantaneous and time-dependent drawdown in water table aquifers. The solutions were shown to be the same as those of Stallman and Hantush for the limiting conditions of small drawdown in shallow aquifers. The theory was subjected to verification using test results from drawdown in a sand model. The tests showed that the inclusion of vertical velocity effects alone is insufficient for substantial progress in unsteady water table drawdown theory. The tests further suggest that inclusion of time-dependent pore drainage will be required for progress in that theory. For this reason, the sand model drawdown data were presented as a more realistic test of water table drawdown theory than are data from a Hele-Shaw apparatus. (Sims-ISWS)
W80-06828

APPLICATION OF THE HEC-4 MONTHLY STREAM FLOW SIMULATION MODEL,
Ohio Dept. of Natural Resources, Columbus. Div. of Water.
For primary bibliographic entry see Field 2E.
W80-06849

FINITE ELEMENTS IN WATER RESOURCES, VOLUME 1.
Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford; May 19-23,

1980. Science and Education Administration, P. O. Box 53326, New Orleans, LA. May 1980. 456 p.

Descriptors: *Mathematical models, *Finite element analysis, *Groundwater, *Water resources, Analytical techniques, Aquifers, Porous media, Analysis, Flow, Seepage, Saline water intrusion, Water resources development, Unsaturated flow, Saturated flow, Infiltration, Water pollution, Leachate, Lakes, Convection, Diffusion.

The objective of this conference was to provide scientists and engineers with a forum for reviewing the state of the art, for presenting new research accomplishments, and for exchanging ideas and experiences in the study of finite-element modeling of water resource systems. Subject areas covered included groundwater movement, seepage, leaky aquifers, aquifer pollution, seawater intrusion, infiltration, and transport phenomena. (See W80-06859 thru W80-06894) (Humphreys-ISWS)
W80-06858

APPLICATIONS OF BOUNDARY ELEMENTS IN WATER RESOURCES,
Southampton Univ. (England). Dept. of Civil Engineering.
C. Brebbia, and L. Wrobel.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 1.3-1.29, 1980. 9 Fig, 3 Tab, 9 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Mathematical models, *Equations, *Potential flow, Finite element analysis, Mathematical studies, Analytical techniques, Mathematics, Model studies, Analysis, Laplaces equation, Darcys law, Porous media, Numerical analysis, Seepage, Flow around objects, Flow, Boundary elements, Flow under dam.

One of the most interesting recent developments in the field of computational mechanics has been the application of integral equation techniques to solve engineering problems. These techniques were largely unknown to engineers who preferred using classical solutions such as finite elements or finite differences. In this paper the fundamentals of boundary elements were presented, explaining how the external surface of the boundary can be divided into a series of elements over which the functions under consideration are assumed to vary in much the same way as in finite elements. This produces a series of nodal unkowns on the surface of the body only which are then related through influence functions. The capability of using different types of surface elements is important as it permits the combination of boundary and finite elements regions without loss of compatibility. (See also W80-06858) (Humphreys-ISWS)
W80-06859

FINITE ELEMENTS IN WATER RESOURCES, VOLUME 2,
Preprints of the Third International Conference (2 Vol.), Mississippi University, Oxford; May 19-23, 1980. Science and Education Administration, P. O. Box 53326, New Orleans, LA. May 1980. 512 p.

Descriptors: *Mathematical models, *Finite element analysis, *Surface waters, *Water resources, Analytical techniques, Water resources development, Lakes, Rivers, Waves(Water), Tides, Open channel flow, Sediment transport, Estuaries, Coasts, Turbulent flow, Viscous flow.

The objective of this conference was to provide scientists and engineers with a forum for reviewing the state of the art, for presenting new research accomplishments, and for exchanging ideas and experiences in the study of finite-element modeling of water resource systems. Subject areas covered in volume 2 included viscous flow, river modeling, ocean modeling, sedimentation processes, and finite-element techniques. (See W80-06858 and W80-06895 thru W80-06934) (Humphreys-ISWS)
W80-06894

FINITE ELEMENT APPROXIMATIONS TO FLOW PROBLEMS,
Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Mathematics.
G. J. Fix.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol.), Mississippi University, Oxford, May 19-23, 1980. p 4.3-4.13, 1980. 3 Fig, 8 Ref. Science and Education Administration, New Orleans, LA. ARO DAAG 2

Descriptors: *Flow, *Finite element analysis, *Mathematical models, Analytical techniques, Flow around objects, Mathematical studies, Equations, Theoretical analysis, Approximation method, Two-dimensional flow, Three-dimensional flow.

There are two major difficulties in using finite element methods to approximate fluid flows. The first is the need to develop an appropriate variational principle. Second, even in those cases where there is a widely accepted variational formulation, it is often of the mixed type and hence serious consideration needs to be given to the type of element used in the method. The author illustrated these with two sample problems. The first is a two-dimensional imcompressible flow past an obstacle using the stream function and vorticity formulation. The major difficulty in this problem is the development of an appropriate variational method. The other example is a three-dimensional incompressible flow using primitive variables. Here the standard Galerkin formulation has been widely accepted; however, since it is of the mixed type only selected finite element spaces will produce stable and accurate approximations. (See also W80-06894) (Humphreys-ISWS)
W80-06895

IMCOMPRESSIBLE FINITE ELEMENT METHODS FOR THE NAVIER-STOKES EQUATIONS,
Paris-6 Univ. (France). Dept of Mathematics.
P. A. Raviart.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol.), Mississippi University, Oxford, May 19-23, 1980. p 4.14-4.30, 1980. 17 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Finite element analysis, *Mathematical models, *Flow, Mathematical studies, Mathematics, Equations, Theoretical analysis, Analytical techniques, Viscous flow, Navier-Stokes equations, Two-dimensional flow, Three-dimensional flow.

Finite element methods for solving the Navier-Stokes equations for an incompressible viscous flow can be divided roughly into two classes. In the first class, based on the classical velocity-pressure formulation, the velocity field is continuous at the inter-element boundaries, while the incompressibility constraint is only approximately satisfied. In the second class, based on more sophisticated formulations, the continuity of the tangential velocity is relaxed at the inter-element boundaries, but the incompressibility condition is exactly satisfied. For a mathematical introduction to both classes of finite element methods, Girault and Raviart (1979a), for instance, were referred to. In this paper the author introduced some methods of the latter class that are successfully used in practice and presented corresponding mathematical results that have been recently obtained. Two finite element methods for the linear stationary two-dimensional Stokes problem were presented and mathematically analyzed. These methods were adapted in order to solve the nonlinear Navier-Stokes equations. (See also W80-06894) (Humphreys-ISWS)
W80-06896

A FINITE ELEMENT WATERSHED MODEL TO PREDICT STORM HYDROGRAPHS, SEDIMENT EROSION AND TRANSPORT,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
D. N. Contractor, B. B. Ross, and V. O. Shanholtz.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol.), Mississippi University, Oxford, May 19-23, 1980. p 6.24-6.34, 1980. 5 Fig, 6 Ref. Science and Education Adminstration, New Orleans, LA.

Descriptors: *Finite element analysis, *Mathematical models, *Watersheds(Basins), *Hydrograph analysis, *Virginia, Sediment transport, Erosion, Hydrographs, Model studies, Analytical techniques, Analysis, Sediment yield, Forecasting, Land use, Infiltration, Runoff, Precipitation excess, Routing, Streamflow, Overland flow, Peak discharge, Suspended load, *Powells Creek(VA).

One of the most important tools necessary in the management of water resources is a model that integrates the spatial variability of soils, landuse, topography, and rainfall on an ungaged watershed and results in streamflow hydrographs. This tudy attempted to develop a hydrologic model with a reasonable degree of reliability in its output when applied to ungaged watersheds and without prior optimization of model parameters. The watershed is subdivided into a finite number of overland flow and channel flow elements. For a given rainfall on each element, the runoff is calculated depending on the soil type and landuse distribution. Even without calibration, the results of this model are satisfactory. The reliability of the model for a given storm event on Powells Creek was determined and indicated the probability that the model will provide results within a given error. The storm hydrograph model forms the basis of the sediment model. Results from the sediment model seem very reasonable, even though data to verify the model are lacking. After verification, the model can be used to compare the sediment loads before and after landuse changes. (See also W80-06894) (Humphreys-ISWS)
W80-06922

THE MOVING INTERFACE PROBLEM WITH FINITE ELEMENTS,
Sydney Univ., (Australia). Dept. of Aeronautical Engineering.
G. P. Steven.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 7.64-7.78, 1980. 9 Fig, 1 Tab, 6 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Finite element analysis, *Interfaces, *Mathematical models, *Flow, Boundary processes, Boundaries(Surfaces), Analytical techniques, Analysis, Model studies, Methodology, Moving interface, One-dimensional model.

One-dimensional model studies were presented on four schemes for accommodating a moving interface across which there are discontinuities in physical parameters. These are; (1) stepping the interface, element at a time, (2) applying a high order interpolation to the physical parameters, (3) using an adaptive grid so that the interface remains an element boundary, and (4) development of a special element that allows the interface to move across it. Results showed schemes 3 and 4 to be the most effective, but for various reasons, 3 was unacceptable for two- or three-dimensional problems; consequently, scheme 4 was developed further for two-dimensional triangles and quadratic isoparametric elements. The former of these was incorporated into a computer model of a Poisson equation and results compared with a conventional finite element solution. From these model test runs it was shown that the use of an element which incorporates a physical discontinuity within itself gives rise to acceptable results. (See also W80-06894) (Humphreys-ISWS)
W80-06930

2B. Precipitation

RAINFALL INTERCEPTION BY A BEECH-PODOCARP-HARDWOOD FOREST NEAR REEFTON, NORTH WESTLAND, NEW ZEALAND,
Forest Research Inst., Christchurch (New Zealand).
For primary bibliographic entry see Field 2A.
W80-06475

LABORATORY STUDIES OF RIMING, AND ITS RELATION TO ICE SPLINTER PRODUCTION,
University of Manchester Inst. of Science and Technology (England). Dept. of Physics.
T. W. Choularton, D. J. Griggs, B. Y. Humood, and J. Latham.
Quarterly Journal of the Royal Meteorological Society, Vol 106, No 448, p 367-374, April 1980. 3 Fig, 14 Ref.

Descriptors: *Rime, *Ice, *Cloud physics, *Laboratory tests, Freezing, Drops(Fluids), Temperature, Frost, Meteorology, Ice splinters, Ice splinter production.

Experiments showed that a supercooled drop accreted on to a rimer in such a way that it lands on an already frozen smaller droplet, may develop a protuberance as it freezes, presumably because the heat loss is fairly symmetrical. These protuberances are found in the temperature range -3 to -8 deg C, and their probability of production reaches a maximum at -5 to -6 deg C of 1 for every 20 drops accreted. The protuberances tend to have a larger aspect ratio and to be longer relative to the drop diameter at lower temperatures. These effects were found to be independent of speed of collection over the range 1.5 to 3 m/s. Due to the strong parallelism between the conditions required for protuberance production and ice splinter ejection during riming, it was suggested that the splinters are a result of explosive fragmentation of about 1% of the protuberances formed. This idea is supported by experimental evidence. (Sims-ISWS)
W80-06496

THE ESTIMATION OF RAIN FROM SATELLITE-BORNE MICROWAVE RADIOMETERS,
McGill Radar Weather Observatory, Ste. Anne de Bellevue (Quebec).
For primary bibliographic entry see Field 7B.
W80-06497

MORE ON THE LA PORTE ANOMALY: A REVIEW,
Illinois State Water Survey, Urbana.
S. A. Changnon, Jr.
Bulletin of the American Meteorological Society, Vol 61, No 7, p 702-711, July 1980. 7 Fig, 39 Ref. NSF ENV77-15375.

Descriptors: *Rainfall, *Variability, *Distribution patterns, *Indiana, Air pollution, Air pollution effects, Weather modification, Spatial distribution, Temporal distribution, Circulation, Air circulation, Hail, Runoff, Precipitation(Atmospheric), Rain, Storms, Meteorology, Reviews, La Porte anomaly.

The anomalous behavior of precipitation in northwestern Indiana (the La Porte anomaly) since the late 1930s has been extensively studied and debated. Local records suggest an upward shift in warm season rainfall, thunderstorms, and hail during the 1935-65 period. The possible causes for this include changed station exposure, a poor observer, urban influences on the atmosphere due to nearby Chicago, and/or shifts in the general circulation patterns. Most debate has centered on the observer error versus urban effects explanation, but the La Porte anomaly has become a cause celebre in the interwoven areas of climate change, air pollution, weather modification, and the quality of climatic records. A variety of recent studies of rainfall conditions and their areas of impact (streamflow, crop yields, and hail losses) show that the anomaly in the La Porte area began to shift locale in the 1950s and then disappeared in the 1960s. Taken in totality, it is likely that the anomalous precipitation at La Porte was due to urban influences on the atmosphere, but the anomaly either ended or shifted into Lake Michigan (where it cannot now be detected) as the general circulation pattern changed, leading to fewer cyclonic passages and a more southward position of the Polar Front in the Midwest since 1960. (Sims-ISWS)
W80-06624

RAINFALL DISTRIBUTION IN NORTHEASTERN THAILAND,
Asian Inst. of Tech., Bangkok (Thailand).
H. N. Phien, A. Arbhabhirama, and A. Sunchindah.
Hydrological Sciences Bulletin, Vol 25, No 2, p 167-182, June 1980. 8 Fig, 5 Tab, 7 Ref.

Descriptors: *Rainfall disposition, *Rainfall, *Climatology, *Asia, Distribution patterns, Irrigation, Annual, Frequency, Distribution, Isohyets, Foreign countries, Evaporation, Statistical methods, Analysis, Monthly, Available water, Data collections, Variability, Foreign research, *Thailand.

This study aimed at providing basic information on rainfall sequences in the region such as the amount and the distribution in space and time. Several other statistical properties such as the persistence, the periodicity and the degree of irregularity of rainfall, and the transition probabilities between rainy and non-rainy days were presented. An assessment of the availability of water for irrigation was also made. The following conclusions were drawn: (1) The annual rainfall in the Northeast increases towards the eastern and northeastern parts of the region. (2) Annual rainfall sequences at the different stations in the region are best fitted by the gamma distribution. (3) Each monthly rainfall sequence has a periodic part consisting of six constituents corresponding to the following six periods--12, 6, 4, 3, 2.4 and 2 months. (4) At each station the rainfall sequence in a month is independent of the rainfall sequences in the other months. (5) Since many monthly rainfall sequences in the Northeast have zero values, the leakage law is most appropriate for fitting these sequences. (6) Monthly rainfall in the region varies greatly from month to month, resulting in high degrees of irregularity, ranging from 45 to 70%. (7) Monthly rainfall also varies greatly from year to year as indicated by the high values for the coefficient of variation. (8) The eastern and northeastern sections of the region are the wettest areas of the Northeast from April to September but they are the driest parts from October to December. The maximum amount of rainfall for the entire region usually occurs in August or September while the minimum normally occurs in December or January. (9) Throughout the year, a dry day is more likely to be followed by a dry day than by a wet day and the amount of daily rainfall mostly falls in the 0-10 mm interval. (10) The driest months of the year are December and January in which a dry day follows a dry day with a probability of around 0.99. (11) The ratio of monthly rainfall at a given probability level to the potential evapotranspiration in the same month varies from month to month. It has low values in the dry season and high values in the rainy season. (Humphreys-ISWS)
W80-06626

THE ACID CONNECTION.
Tennessee Valley Authority, Chattanooga. Office of Natural Resource.
Impact, Vol 3, No 4, p 2-10, July 1980, Rucker, D., Ed., 10 Fig.

Descriptors: *Acidic water, *Precipitation(Atmospheric), *Environmental effects, *Water pollution, Physical properties, Chemical properties, Biological properties, Water properties, Acidic soils, Rain water, Weather modifications, Pollutants, Fishkill, Air pollution, Atmosphere, Nitrogen compounds, Sulfur compounds, Evaluation, Rivers, Lakes, Vegetation, Soils, Surface waters, Forecasting, Tennessee Valley Authority, Fossil fuels, Coals, Laboratory tests, On-site investigations.

The problems of defining and understanding the physical, chemical and biological processes involved in acid rain are discussed. The acidity of rain is measured by the pH scale; 'pure' rain would have a pH of about 5.6 and the average pH measured for rains in parts of the northeastern U.S. range from 4 to 4.2 with the most extreme single value of pH 2.3. No complete, detailed historical measurement of rainfall acidity and its impacts are available in the country so a national effort is underway to coordinate all related research efforts. Air pollution is known to alter the acidity of precipitation by increasing sulfur oxide and nitrogen oxide concentrations and this in effect will increase with increasing use of coal as fuel. Fish and aquatic life in rivers and lakes with no natural 'buffering' system against acid rain may experience a decline; the rivers and lakes may become completely dead in the future. The TVA is presently engaged in active research in rainfall monitoring, atmospheric movement of pollutants, and laboratory and field studies of vegetation, soils, and surface waters to define present conditions and indicate possible future trends. The long-range transport, chemical transformation, and ultimate fate of air pollutants and the effect of acid rain on soil chemistry is also being investigated. As of now, there is no clear evidence of how much acidity the environment can tolerate and how much needs to be controlled. (Sidney-IPA)
W80-06641

RAINFALL STATISTICAL PROPERTIES IN NAPLES,
Naples Univ. (Italy). Ist. di Geologia e Geofisica.
A. Palumbo, and A. Mazzarella.
Monthly Weather Review, Vol 108, No 7, p 1041-1045, July 1980. 4 Fig, 1 Tab, 17 Ref.

Descriptors: *Rainfall, *Statistics, *Cities, Variability, Statistical methods, Markov processes, Mathematical models, Forecasting, Urbanization, Effects, Meteorology, *Naples(Italy).

In order to collect further information about recent microclimatic changes in urban areas, an analysis of the secular variations of rainfall intensity has been worked out. A significant increase in rainfall due to urbanization process has been ascertained in the last years. A detailed investigation was performed by studying the records of rainfalls, both showery and continuous, in Naples. The rainfalls were separately examined because of their different effect on the city: the former being more localized, the latter generally extending over wide areas. The analysis showed that a major portion of variance in continuous rainfall rate, in cases of static instability and low surface wind intensity, exhibited a persistence that can be described by a first-order Markov process. Moreover, for the continuous rainfalls, a method for possible prediction of the total mean rainfall rate was indicated. (Sims-ISWS)
W80-06650

MESOSCALE CHARACTERISTICS OF THE TEXAS HIPLEX AREA DURING SUMMER 1978,
Texas A and M Univ., College Station. Dept. of Meteorology.
M. E. Sienkiewicz, J. R. Scoggins, S. F. Williams, and M. L. Gerhard.
Texas Department of Water Resources Report LP-123, March 1980. 609 p, 622 Fig, 1 Tab, 7 Ref. 14-06-D-7587.

Descriptors: *Convection, *Clouds, *Meteorology, *Probable maximum precipitation, *Moisture availability, *Rainfall intensity, *Texas, Humidity, Rainfall, Temperature, Climatology, Precipitable water, Precipitation, Water vapor, Wind velocity, Air circulation, Atmosphere, Cycles, Energy transfer, Cloud cover, Energy budget, Water supply.

Basic understanding of interactions between convective clouds and their environment at the surface and aloft is essential in development of rainfall enhancement technology. This report contains a mesoscale analysis for 26 case study days under the Texas HIPLEX program from data collected between June 1 and July 26, 1978. The mesoscale experiment was approximately bound by Midland-Robert-Lee-Clairemont-Tahoka-Seminole-Midland, and included nineteen surface measurement stations (temperature, relative humidity, pressure, wind direction and speed), four atmospheric sounding locations, three radar locations (convective echoes), and numerous rainfall measurement locations. Results from the analyzed data are presented for each day separately. Composite analyses of surface variables, and upper level kinematic, moisture, atmospheric and energy processes associated with convective activity are also given. Results show pronounced interactions between the environment and convective activity, with marked changes in nearly all surface and upper-air varia-

bles occurring in association with convective activity. Analysis of individual days or composite analyses suggest that surface processes (moisture divergence, vertical moisture flux, vertical motion) are important in formation/maintenance of convective clouds, and are reflected in upper-air analyses and energy processes and time changes. The results are consistent with and support similar analyses for 1976 and 1977. (Zielinski-IPA)
W80-06737

A SHORT NOTE ON ERRORS IN RAINFALL MEASUREMENT,
University of Durban-Westville (South Africa). Dept. of Geography.
G. Du T. De Villiers.
Water S. A., Vol 6, No 3, p 144-148, July, 1980. 3 Fig, 2 Tab, 8 Ref.

Descriptors: *Rain gages, *Precipitation(Atmospheric), *Rainfall, *Meteorology, *Precipitation gages, Rainfall intensity, Rain, Instrumentation, Rain water, Gaging stations, Gauges, Water measurement, Evaluation, Theoretical analysis, South Africa.

A rainfall measurement experiment was set up in the University meteorological station to quantify catch variability in various types of rain gauges. Six gauges collected data during the 1978-79 rain season. Four gauges were set up in the normal vertical fashion at 1.2 or 2.4 m above ground or without/with a Nipher screen; the remaining two being a pit gauge and an inclined rotating gauge. Thirty-seven storms were selected for analysis. No meaningful differences could be traced between the data sets of the pit and shielded gauges, and the catch averages per storm was thus accepted as the true values for the two gauges. The Nipher screen gauge consistently showed lower readings than the perpendicular control gauges, contrary to the discussed theory and was seemingly caused by turbulent eddying. The largest source of error connected to gauge readings was the assumption that such readings represent the actual precipitation at the site. This does not make percent rainfall records useless or preclude use of vertical rain gauges. If the components of rainfall are known, rain vectors for storms of uniform/varying direction and inclination can be determined and used to compute true rainfall from a vertical gauge. (Zielinski-IPA)
W80-06856

2C. Snow, Ice, and Frost

GLACIOLOGICAL DATA: SNOW COVER.
Colorado Univ. at Boulder. Inst. of Arctic and Alpine Research.
Report GD-6, August 1979. 110 p, 11 Fig, 14 Tab, 94 Ref, 3 Append.

Descriptors: *Snow, *Snow cover, *Glaciology, *United States, Data collections, Bibliographies, Computers, Data storage and retrieval, Research and development, Ice, Satellites(Artificial), Photography, Sea ice, Snow surveys, On-site investigations, *Norway, Snow research.

This issue returned to the pattern of a selected bibliography and supporting data-related articles. The contributions included here provide perspectives on the importance of snow and the organization of snow research in Norway and the United States, as well as accounts of global and regional data sets. The material thereby complements the workshop reports on snow cover data published in Glaciological Data Report GD-5. The last 12 months have seen the implementation of a computerized bibliographic data file and a steady growth in the WDC's accessions of bibliographic and other data. Specific data holdings will be described in future issues. Specific information on existing snow cover (and sea ice) data sets, based on current inventory assessment, will be contained in the next issue. (See also W77-12799) (Froehlich-ISWS)
W80-06474

A SNOWMELT AND WATER EQUIVALENT GAUGE FOR BRITISH CONDITIONS,
University Coll. of Wales, Aberystwyth. Dept. of Geography.
For primary bibliographic entry see Field 7B.
W80-06480

GLACIAL GEOLOGY AND STRATIGRAPHY OF WESTERN NEW YORK NUCLEAR SERVICE CENTER AND VICINITY, CATTARAUGUS AND ERIE COUNTIES, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
R. G. LaFleur.
Geological Survey open-file report 79-989, 1979. 17 p, 5 Fig, 8 Plates, 1 Tab, 16 Ref.

Descriptors: *Glacial drift, *Hydrogeology, *Stratigraphy, *Glacial sediments, *Radioactive wastes, Radioisotopes, Path of pollutants, Groundwater movement, Maps, New York, *Western New York Nuclear Service Center(NY), *Cattaraugus County(NY), *Erie County(NY).

A detailed glacial geologic map at a scale of 1:24,000, embracing a 165 square-mile area in Erie and Cattaraugus Counties, NY, shows 27 mapping units, including the till complex in which the West Valley radioactive-waste burial site is located. Stratigraphic relationships at 24 boreholes at the burial site and 6 newly described exposures indicate the age of the till complex to be early late Woodfordian (post-Kent, pre-Lake Escarpment, Valley Heads), equivalent to the Lavery glacial advance. Correlations of mapping units and measured sections with Woodfordian and older glacial and deglacial episodes are proposed. The Lavery till is confined to the valleys of Cattaraugus Creek and its major tributaries. At the waste-burial site in Buttermilk Creek Valley, the Lavery is an interfingering complex of clayey-silt till and thinner beds of deformed, poorly stratified lacustrine clay and silt. Ice readvance after the Kent glacial recession and Erie Interstade erosion imponded proglacial lake water in Buttermilk Creek Valley and covered post-Kent kame deltas and Erie channel gravels with as much as 130 feet of till. The Lavery till thins southward to a thickness of 80 feet at the waste-burial site and to less than 16 feet near the hamlet of West Valley. Water from the Lavery till may flow through subjacent Erie channel gravel and Kent-recessional kame delta sand to the bluffs along Buttermilk Creek, where discharge of water from these exposed pervious deposits appears to cause major slumps. (USGS)
W80-06531

STANDARDIZATION OF TESTING METHODS FOR ICE PROPERTIES,
International Association for Hydraulic Research, Delft (Netherlands).
Journal of Hydraulic Research, Vol 18, No 2, p 153-165, 1980. 2 Fig, 15 Ref.

Descriptors: *Ice, *Testing, *Physical properties, *Standards, Testing procedures, Methodology, Sea ice, Glaciers, Lake ice, Sampling, Crystallography, Laboratory equipment, Compressive strength, Tension, Friction, Flexural strength.

Due to the fact that almost every ice research group uses different testing methods, the results of nominally similar tests can vary greatly. This is, of course, a hinderance to the Ice Engineering field. In order to improve the quality, comparability, and usefulness of the test data resulting from mechanical property investigations, the IAHR Section on Ice Problems considered it necessary to standardize ice testing methods. In this paper, the Working Group of the IAHR Section on Ice Problems proposed its recommendations for the 'Standardization of Testing Methods for Ice Properties'. It was noted that the suggested recommendations remain open to revision as the development of ice testing methods progresses. (Humphreys-ISWS)
W80-06609

THE MELTING OF ICE IN COLD STRATIFIED WATER,
Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physic.
H. E. Huppert, and E. G. Josberger.
Journal of Physical Oceanography, Vol 10, No 6, p 953-960, June 1980. 6 Fig, 1 Tab, 9 Ref. ONR 30-262-3149, NSF 30-262-1946.

Descriptors: *Ice-water interfaces, *Laboratory tests, *Melting, *Boundary processes, Ice, Saline water, Density stratification, Melt water, Analytical techniques, Analysis, Testing procedures, Water temperature, Cold regions.

The melting of ice in cold water vertically stratified with salt was considered. The study extended previous investigations of ice melting in cold water at uniform salinity and in warm water with a salinity gradient. It was found, in agreement with the results of the latter study, that the meltwater spreads out in a series of horizontal layers. This motion tends to convert the initially smooth salinity distribution into one with much larger gradients in the interfaces between the layers. Also discussed were the results of an experiment with a stratified region above a region of uniform salinity. The convective plume that formed in the lower region penetrated into the upper region, while a series of horizontal layers in the upper region extended beyond the plume. To apply these results to polar oceans it is necessary to assume that it is valid to extrapolate them to smaller salinity gradients than is possible to investigate in the laboratory. Data from the Antarctic indicate ambient temperatures of around 0 C and salinity gradients in the summer varying between 0.001%/m in the upper 100 m of the Weddell Sea and 0.00001%/m in a relatively unstratified region down to 400m. Considering a nominal 1 C temperature difference between the ice and the ocean, the authors calculated a corresponding layer scale of order 10 m in the upper 100 m and 1000 m below that. The latter value indicates that the influence of the salinity gradient is inconsequential at depth, and convection up the side of the ice occurs. Because the different parameter range and scale in the ocean are unobtainable in the laboratory, the authors suggested that to further validate their ideas required a field program of observations to examine the temperature, salinity and velocity structure in the vicinity of icebergs. (Humphreys-ISWS)
W80-06620

AIRBORNE UHF RADIO ECHO-SOUNDING OF THREE YUKON GLACIERS,
British Columbia Univ., Vancouver. Dept. of Geophysics and Astronomy.
B. B. Narod, and G. K. C. Clarke.
Journal of Glaciology, Vol 25, No 91, p 23-31, 1980. 6 Fig, 1 Tab, 10 Ref.

Descriptors: *Glaciers, *Sounding, *Remote sensing, *Canada, *Instrumentation, Ice, Surveys, Radio waves, Depth, Measurement, On-site investigations, Electronic equipment, Exploration, *Rusty Glacier, *Trapridge Glacier, *Hazard Glacier, Radio echo-sounding.

A high-resolution radio echo-sounder operating at a frequency of 840 MHz was developed for airborne sounding of small and medium-sized polar glaciers and ice caps. The sounder uses a compact, high-gain antenna which suppresses valley-wall echoes and simplifies operation from light aircraft. Successful field trials were carried out on Rusty, Trapridge, and Hazard Glaciers, Yukon Territory, Canada. Results compare well with ice depths obtained from earlier ground-based soundings on Rusty and Trapridge Glaciers. The maximum ice thickness encountered was 200 m on Hazard Glacier. Owing to the high operating frequency, random scattering from inhomogeneities within the ice is a major cause of signal degradation. For this reason the sounder cannot penetrate great thicknesses of temperature or debris-rich ice. Spatial averaging, an immediate result of operating from a moving platform, reduces the effects of back-scattered 'clutter'. (Humphreys-ISWS)
W80-06663

A THERMOHYDRODYNAMIC MODEL OF AN ICE SHEET,
Akademiya Nauk SSSR, Leningrad. Inst. Okeanologii.
M. Ya. Verbitsky, and D. V. Chalikov.

Journal of Glaciology, Vol 25, No 91, p 61-67, 1980. 3 Fig, 5 Ref.

Descriptors: *Glaciers, *Ice, *Model studies, Mathematical models, Equations, Temperature, Heat, Heat flow, Precipitation(Atmospheric), Volume, Glaciology, *Antarctic, Ice sheets.

The purpose of this paper is to consider an ice-sheet model based on joint solution to the dynamic equations and equations of heat conductivity in which the surface relief is one of the unknown functions. The proposed model is applicable to calculations of the Antarctic ice sheet. Results of a numerical experiment for present values of the temperature of the ice surface and precipitation as well as for their separate and simultaneous increase by 2, 4, or 6 deg and 10, 20, or 30% are given. (Sims-ISWS)
W80-06664

GLACIOLOGICAL INVESTIGATIONS OF THE TROPICAL QUELCCAYA ICE CAP, PERU,
Ohio State Univ. Research Foundation, Columbus. Inst. of Polar Studies.
L. G. Thompson.
Journal of Glaciology, Vol 25, No 91, p 69-84, 1980. 15 Fig, 1 Tab, 13 Ref. NSF ATM 75-15513A02, GV-41411.

Descriptors: *Glaciers, *Ice, *On-site investigations, Sampling, Cores, Oxygen isotopes, Temperature, Precipitation(Atmospheric), Density, Particle size, Percolation, Glaciology, *Ice caps, *Peru, *Quelccaya Ice Cap(Peru).

Glaciological results of the continuing investigations of the Quelccaya ice cap located at lat. 13 deg 56 min S., long. 70 deg 50 min W., in the Cordillera Oriental of southern Peru were presented. Ice cores to a depth of 15 m have been retrieved from the summit dome (5650 m), middle dome (5543 m), and south dome (5480 m) and sampled in detail for microparticle, oxygen-isotope, and total-beta-activity measurements. Results of these core analyses indicated that although the summit of this ice cap is only 300 m above the annual snow line and the firn is temperate, an interpretable stratigraphic record is preserved. The marked seasonal ice stratigraphy is produced by the marked seasonal variation in regional precipitation. High concentrations of microparticles and beta-radioactive material occur during the dry season (May-August). Microparticles deposited during the rainy season are larger than those deposited during the dry season. On the Quelccaya ice cap the most negative delta 180 values occur during the warmer rainy season (the opposite occurs in polar regions). The near-surface mean delta value of -21 parts per thousand is remarkably low for this tropical site where the measured mean annual air temperature is -3 C. The seasonality of the microparticles, total beta activity, and isotope ratios offers the prospect of a climatic ice-core record from this tropical ice cap. (Sims-ISWS)
W80-06665

MICROWAVE BRIGHTNESS OF POLAR FIRN AS MEASURED BY NIMBUS 5 AND 6 ESMR,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 7B.
W80-06666

NIVATION: AN ARCTIC-ALPINE COMPARISON AND REAPPRAISAL,
Maryland Univ., College Park. Dept. of Geography.
C. E. Thorn, and K. Hall.
Journal of Glaciology, Vol 25, No 91, p 109-124, 1980. 5 Fig, 7 Tab, 40 Ref.

Descriptors: *Snow, *Colorado, *Glaciology, *Artic, *Alpine, Glaciers, Weathering, Snow cover, Geomorphology, Solifluction, Erosion, On-site investigations, Methodology, Freezing, Temperature, Thawing, Snowmelt, Water quality, Data collections, Calcium, Magnesium, Silica, Aluminum, Iron, Potassium, Sodium, Hardness(Water), *Norway, *Nivation.

Nivation is a collective noun identifying a set of geomorphic processes, comprised of an indeterminate numer of elements and of unknown relative importance, for which there is little likelihood of ever producing a precise definition. Instead, attention should first be directed towards the relationships between snow-packs and individual geomorphic processes. The relationship between freezing amplitude in the bedrock, snow cover, and aspect at an Arctic site in northern Norway and an apline site in the Front Range, Colorado, is complex. Comparison of field data and laboratory criteria permit several conflicting interpretations. If oscillations across 0 C, regardless of freezing amplitude, are critical, the alpine site is potentially a more active freeze-thaw weathering regime, with a primary springtime peak and a secondary fall peak. If a freezing amplitude of -5 C is required for effective freeze-thaw weathering then the alpine site is largely inactive and the Arctic active (but with only a single fall peak). Chemical weathering is much more important at snow-patch sites than has traditionally been recognized. Mass wasting at colluvial sites subject to snow patches is dominated by interaction between overland flow and solifluction when the site is unvegetated, and by solifluction when it is vegetated. Given contemporary knowledge of snow and glacial geomorphology, there appears to be no threshold, only differences of intensity. Resolution of the disruptive mechanism associated with bedrock freezing and its constraining temperature and moisture requirements is the most pressing present problem in the field of snow geomorphology. (Humphreys-ISWS)
W80-06667

A SCANNING ELECTRON MICROSCOPE EXAMINATION OF SUBGLACIAL QUARTZ GRAINS FROM CAMP CENTURY CORE, GREENLAND--A PRELIMINARY STUDY,
Queen's Univ., Belfast (Northern Ireland). Dept. of Geography.
W. B. Whalley, and C. C. Langway, Jr.
Journal of Glaciology, Vol 25, No 91, p 125-131, 1980. 11 Fig, 13 Ref.

Descriptors: *Till, *Glacial sediments, *Quartz, *Laboratory tests, Sands, Testing procedures, Electron microscopy, Particle shape, Ice, Aeolian soils, Analytical techniques, *Greenland, Angularity, Roundness.

The surface textures and angularity-roundness characteristics of quartz sand grains of till from the base of the Greenland ice sheet at Camp Century were examined with a scanning electron microscope. Two basic populations were revealed; an angular component which shows grains with edge abrasion and attrition indicative of subglacial grinding, and a well-rounded component with the characteristics of aeolian transport. It was suggested that these two populations were mixed subglacially, the aeolian fraction having been produced at some stage before the ice sheet encroached over the area of their deposition. (Humphreys-ISWS)
W80-06668

DYNAMIC BEHAVIOR OF DISLOCATIONS IN HF-DOPED ICE IH,
Institut National des Sciences Appliquees, Lyon (France). Groupe d'Etudes de Metallurgie Physique et de Physique des Materiaux.
J. Perez, C. Mai, J. Tatibouet, and R. Vassoille.
Journal of Glaciology, Vol 25, No 91, p 133-149, 1980. 12 Fig, 1 Tab, 16 Ref.

Descriptors: *Ice, *Crystallography, *Model studies, *Physical properties, Laboratory tests, Temperature, Shear, Analysical techniques, Analysis, Mathematical models, Stress, Measurement, Friction, Velocity, HF-doped ice.

A model of dislocation glide in ice Ih was recently proposed. This model was developed on certain assumptions, namely that transitions occur through cooperative movements of H2O molecules in the noncrystalline core of dislocations. A relation between the velocity v sub d of linear defects and shear stress tau or temperature T is obtained. This relation shows that v sub d varies linearly with tau at low values of tau and (or) T but varies more rapidly at higher stresses; this nonlinearity is more pronounced the higher the temperature. Such an analysis was extended in order to take into account doping effects. The case of HF-doped ice was considered: it was shown that there is a strong accumulation effect of HF molecules in the dislocation cores, which induces an increase of the rate of transitions. The results are in agreement with experimental data concerning both the velocity of dislocations and high-temperature internal friction in HF-doped ice. (See also W79-09369) (Humphreys-ISWS)
W80-06669

BOTTOM CREVASSES,
Northwestern Univ., Evanston, IL. Dept. of Materials Science.
J. Weertman.
Journal of Glaciology, Vol 25, No 91, p 185-188, 1980. 10 Ref.

Descriptors: *Icebergs, *Sea ice, *Cracks, *Model studies, Mathematical models, Freezing, Creep, Ice, Temperature, Physical properties, Crevasses, Bottom crevasses, Ice shelves.

An approximate calculation was made of the rate at which a bottom crevasse in a cold ice shelf or tabular iceberg can close by freezing of water and can creep open through the creep deformation of ice. In all but the thickest ice shelves and icebergs, those with a thickness greater than about 400 m, the freezing process is the more important mechanism if the ice is cold (less than -10 C). Consequently in a cold iceberg or ice shelf a bottom crevasse, once formed, will freeze shut. (Sims-ISWS)
W80-06777

THE EXISTENCE OF MULTIPLE STEADY STATES IN THE FLOW OF LARGE ICE MASSES,
Trinity Coll., Dublin (Ireland). School of Mathematics.
A. C. Fowler.
Journal of Glaciology, Vol 25, No 91, p 183-184, 1980. 3 Ref.

Descriptors: *Glaciers, *Surges, *Stability, *Model studies, Mathematical models, Temperature, Heat flow, Ice, Glaciology, Evaluation.

The possibility of the occurrence of thermal instability in ice sheets and glaciers is discussed. This may arise from the nonlinear viscous heating term, which could provide for the existence of multiple steady states in the flow and temperature fields. Attention is drawn to certain limitations, in several authors' models (Robin, 1955; Clark and others, 1977; and Yuen and Schubert, 1979) which may render their conclusions inaccurate. (Sims-ISWS)
W80-06778

FIELD TECHNIQUES FOR EXPERIMENTAL STRESS ANALYSIS IN ARCTIC SEA ICE,
Helen Hayes Hospital, West Haverstraw, NY.
G. V. B. Cochran.
Journal of Glaciology, Vol 25, No 91, p 175-182, 1980. 4 Fig, 18 Ref.

Descriptors: *Sea ice, *Strain measurement, *Strain gages, *Arctic, On-site investigations, Equipment, Instrumentation, Evaluation, Stress, Strain, Ice, Glaciers, Tension, Mechanical properties, Physical properties, Glaciology.

Increasing interest is being directed toward studies involving measurement of strain and strain-rates in sea and glacier ice. A number of techniques for obtaining these data over gage lengths ranging from 1 m to several kilometers have been reported, but there has been little experience with shorter lengths. Use of commercially available electrical resistance strain-gages (length 5-20 cm) intended for embedment in concrete offers a new approach in which multiple gage, two- and three-dimensional arrays can be installed in ice with minimum effort and monitored with portable equipment. This report described a pilot study designed to demonstrate the use of three types of electrical

resistance strain gages in sea ice under exposed field conditions. Results included detection of variations in strain fields related to tidal currents. (Sims-ISWS)
W80-06779

A FAST LIGHT-WEIGHT CORE DRILL,
Copenhagen Univ. (Denmark). Geophysical Isotope Lab.
S. J. Johnsen, W. Dansgaard, N. Gundestrup, S. B. Hansen, and J. O. Nielson.
Journal of Glaciology, Vol 25, No 91, p 169-174, 1980. 3 Fig, 4 Ref.

Descriptors: *Ice, *Cores, *Core drilling, *Drilling equipment, On-site investigations, Glaciers, Design, Equipment, Evaluation, Sampling, Drilling, Glaciology, Engineering.

A core drill capable of drilling to more than 100 m depth in ice is described. It was designed with a view to fast operation and easy transport, core handling, and maintenance. A total of 800 m of core was recovered to a maximum depth of 110 m on the Greenland ice sheet. The average length of the core increments was 1.2 m in firm and 1.0 m in ice. The quality of the core was excellent, i.e. no 'wafering' and only a few breaks. (Sims-ISWS)
W80-06780

ELASTIC CONSTANTS OF ICE BY BRILLOUIN SPECTROSCOPY,
Memorial Univ. of Newfoundland, St. Johns. Dept. of Physics.
P. H. Gammon, H. Kiefte, and M. J. Clouter.
Journal of Glaciology, Vol 25, No 91, p 159-167, 1980. 3 Fig, 3 Tab, 28 Ref.

Descriptors: *Ice, *Elastic theory, *Laboratory tests, *Spectroscopy, Physical properties, Mechanical properties, X-rays, X-ray spectroscopy, Crystals, Temperature, Rheology, Brillouin spectroscopy, Elastic constants.

Brillouin spectroscopy has been used to measure the adiabatic elastic constants of laboratory-grown pure monocrystalline ice Ih at -3 C. The values obtained were (in units of 10 to the 8th power N/sq m): c sub 11 = 136.96 + or - 0.60, c sub 12 = 69.66 + or - 0.45, c sub 13 = 56.28 + or - 0.31, c sub 33 = 147.02 + or - 0.68, c sub 44 = 29.59 + or - 0.15. Comparison of these values with ultrasonic measurements quoted in the literature revealed no significant acoustic dispersion in ice over frequencies ranging to 10 to the 10th power Hz. However, the results suggested that the elastic constants of ice may depend on the precise crystal quality and age of a given sample. The low experimental error in the values obtained, along with the inherent versatility of the method, indicated that Brillouin spectroscopy is an effective technique for systematically investigating the elastic properties of ice samples formed under natural conditions. (Sims-ISWS)
W80-06781

DOES THE PERMANENT CREEP-RATE OF POLYCRYSTALLINE ICE INCREASE WITH CRYSTAL SIZE,
Centre National de la Recherche Scientifique, Grenoble (France), Lab. de Glaciologie.
P. Duval, and H. Le Gac.
Journal of Glaciology, Vol 25, No 91, p 151-157, 1980. 4 Fig, 1 Tab, 15 Ref.

Descriptors: *Ice, *Mechanical properties, *Creep, *Crystals, Laboratory tests, Physical properties, Stress, Strain, Temperature, Rheology, Particle size, Crystal size, Creep rates, Polycrystalline ice.

Uniaxial compression creep tests were performed on artificial and natural polycrystalline ices at temperatures near -7 C. The grain-size range investigated was from 1 to 10 mm. Contrary to previous results, the permanent creep-rate was not found to increase with crystal size. Only the transient creep appeared to be sensitive to variations in crystal size. (Sims-ISWS)
W80-06782

PRESSURE WAVES IN SNOW,
Cold Regions Research and Engineering Laboratory, Hanover, NH.
R. L. Brown.
Journal of Glaciology, Vol 25, No 91, p 99-107, 1980. 5 Fig, 9 Ref. ARO DRXRO-RR P-15413GS.

Descriptors: *Snow, *Physical properties, *Pressure, *Model studies, Mathematical models, Laboratory tests, Density, Velocity, Stress, Mechanical properties, Ice, Pressure waves, Stress waves, Shock waves, Plastic waves.

A dynamic constitutive law was used to study the response of medium-density snow to shock waves. The results showed good correlation between theory and experiment, except for low-intensity shocks which produce small permanent density changes. In this case the validity of the data is questioned, although further experimental work is needed to settle this question. The results of this work also partially explained why snow is so effective in absorbing energy associated with stress waves. This was felt to be due to the work-hardening characteristics of snow. (Sims-ISWS)
W80-06783

THE PENDULAR-FUNICULAR LIQUID TRANSITION IN SNOW,
Innsbruck Univ. (Austria). Inst. of Experimental Physics.
A. Denoth.
Journal of Glaciology, Vol 25, No 91, p 93-97, 1980. 2 Fig, 7 Ref. DA-ERO 76-G-038.

Descriptors: *Snow, *Electrical properties, *Drainage, *Moisture content, Measurement, On-site investigations, Laboratory tests, Porosity, Pores, Density, Permeability, Theoretical analysis, Equations, Precipitation(Atmospheric), Dielectrical properties.

The way free water is distributed around contact points of ice grains was recorded by measuring the dielectric constant of the porous system which constitutes snow. Within the saturation range of 11% to 15% of the pore volume, a transitional range from the 'pendular' to the 'funicular' mode of distribution of free water occurs. By measuring the drainage-flow of free water through snow, additional information as to the upper limit of the pendular distribution was obtained. This upper limit was reached at a saturation of approximately 14% of the pore volume. (Sims-ISWS)
W80-06784

ON FINITE ELEMENT ANALYSIS OF NON-LINEAR HEAT TRANSFER WITH PHASE CHANGES,
Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
K. J. Bathe, and M. R. Khoshgoftaar.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 7.12-7.29, 1980. 7 Fig, 2 Tab, 10 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Finite element analysis, *Mathematical models, *Heat transfer, *Boundary processes, Freezing, Equations, Analytical techniques, Analysis, Model studies, Heat flow, Temperature, Conductivity, Specific heat, Latent heat, Frozen ground, Ice, Reservoirs.

In this paper, the authors were concerned with the analysis of temperature distributions and heat flow when phase changes take effect. Practical applications in water resource engineering are encountered, for example, in the analysis of ground freezing in an embankment or in the prediction of ice formation in a reservoir structure. The objective was to propose an improved incremental finite element formulation for the analysis of nonlinear heat transfer with phase changes. Some specific characteristics of the solution method are: The original finite element mesh is not changed; the latent heat effect is approximated by using a temperature-dependent heat generation or heat absorption in the phase transition zone plus a variation of heat capacity in the vicinity of the transition surfaces for each time interval; and, the heat flow equilibrium is assured by a heat flow equilibrium iteration. The solution procedure was implemented and the results obtained in the analyses of some problems were presented. The preliminary analysis results are encouraging. (See also W80-06894) (Humphreys-ISWS)
W80-06926

2D. Evaporation and Transpiration

FOREST MANAGEMENT EFFECTS ON INTERCEPTION, EVAPORATION, AND WATER YIELD,
Forest Research Inst., Christchurch (New Zealand).
A. J. Pearce, and L. K. Rowe.
Journal of Hydrology (New Zealand), Vol 18, No 2, p 73-87, 1979. 48 Ref, 1 Append.

Descriptors: *Forest management, *Forests, *Evaporation, Transpiration, Land use, Canopy, Forestry, *Interception, Water yield, Rainfall, Water balance, Watersheds(Basins), *New Zealand, *Evaporative losses, *Coweeta(NC), Canopy wetness, Surface resistance, Vegetation changes, Hardwood forest, Native forest catchments.

Water balance data for New Zealand forests with rainfall ranging from 1300 mm/year to 2650 mm/year showed that interception was a major component of the total evaporative loss. Interception losses increased with annual rainfall and duration of canopy wetness. In the wetter environments studied, interception losses were approximately double the losses in transpiration. During rainfall, high evaporation rates of intercepted water were implied by the observed losses and these conformed to theoretical expectations given that surface resistance reduced to zero or near-zero when the forest canopy was wet. Using New Zealand data, some preliminary estimates of likely water yield changes as a consequence of vegetation changes were made for selected combinations of climate and land-use change. (Roberts-ISWS)
W80-06476

DETERMINATION OF ACTUAL EVAPORATION FOR HYDROLOGICAL BUDGETS USING INFRA-RED THERMOMETRY BY REMOTE SENSING (DETERMINATION DE L'EVAPORATION REELLE DANS LES BILANS HYDROLOGIQUES PAR LA TELEDETECTION EN THERMOGRAPHIE INFRA-ROUGE),
Centre de Recherches, Avignon (France). Station de Bioclimatologie.
B. Seguin.
Hydrological Sciences Bulletin, Vol 25, No 2, p 143-153, June 1980. 5 Fig, 18 Ref.

Descriptors: *Evaporation, *Remote sensing, *Estimating, *Hydrologic budget, *Boundary processes, Hydrologic cycle, Evapotranspiration, Foreign research, Infra-red radiation, Water balance, Energy budget, Soils, Watersheds(Basins), Measurement, Humidity, Temperature, Air-water interfaces, *France, Thermographs.

On a regional scale (about 10 to 100,000 sq km) estimations of actual evapotranspiration (ET) for water balance equations are generally missing. The various methods available at present were briefly described and discussed. The use of remote sensing, in particular infra-red thermometry by satellite in conjunction with soil energy budget data, is the only method to provide satisfactory data on the same scale in space and time for water balance models. This method is being studied at the INRA Bioclimatology Station at Avignon in the framework of the European 'Tellus' project for using HCMM satellite data. Systems for continuously recording the components of the energy budget and ET have been installed in the Crau plain, north of Marseilles, in both a dry area and a large area of irrigated pastures. By combining the recorded measurements with the satellite data and starting from values for elements of 25 ha (500 m X 500 m), the ET for the whole of the Crau plain can be

estimated. First results were analyzed and the possibilities and limitations of the method were discussed. (Humphreys-ISWS)
W80-06482

PROCESS AND PLANT FOR RECOVERING WATER FROM MOIST GAS,
Maschinenfabrik Augsburg-Nuernbert A. G., Munich (Germany, F.R.).
W. Bulang.
U.S. Patent No. 4,185,969, 6 p, 2 Fig, 15 Ref; Official Gazette of the United States Patent Office, Vol 990, No 5, p 1719, January 29, 1980.

Descriptors: *Patents, *Humidity, *Moisture content, *Solar distillation, Separation techniques, Absorption, Condensation, Water recovery techniques, Atmosphere, Solar collectors.

A process and an apparatus for recovering water from moist gas, e.g., humid air, are disclosed. The apparatus comprises fans, solar energy collectors, moisture absorber beds, and heat-accumulators which are connected by conduits in such a manner that in a first reaction stage, e.g., at night time, humid air, is sucked into the apparatus, is divided into two partial flows, the first of which is passed through the absorber beds in parallel or in series, so that water is absorbed in the absorber beds, and then discharged. In a second reaction stage, e.g., during the daytime, a flow of gas is preferably repeatedly, circulated in series from the fan through the solar energy collectors and absorber beds which are connected in alternating sequence and then through the heat-accumulators in series and back to the fan, whereby water is re-desorbed from the absorber beds and condensed on the surfaces of the heat-accumulators. (Sinha-OEIS)
W80-06570

MEASUREMENT OF EVAPORATION FROM SALT WATER PAN,
Meteorological Research Inst., Tokyo (Japan).
T. Fujita, and N. Honda.
Papers in Meteorology and Geophysics, Vol 31, No 1, p 1-6, March 1980. 4 Fig, 5 Ref.

Descriptors: *Evaporation, *Salts, *Saline water, *Evaporation pans, Salinity, Sampling, Measurement, Meteorological data, Evaporimeters, Winds, Wind velocity, *Electrical conductivity technique, Sampling error, Freshwater pan, Vertical vapor fluxes, Atmospheric conditions.

An electrical conductivity technique was used to detect a small amount of salinity change with an accuracy of + or - 0.003%, thus permitting small amounts of water evaporation to be measured. Two circular evaporimeter pans, 50 cm in diameter and 60 cm deep, were installed in grass plots with their tops almost even with the ground but extending 10 cm above ground level. Both pans were made of iron and painted white. One pan contained salt water and the other freshwater. For a long interval of time, the amounts of evaporation from the salt water pan and those from the freshwater pan were approximately equal. The measuring errors of the depth of freshwater tended to become larger as the observational time interval shortened. Even a trace amount of evaporation during a short time interval could be detected by measuring salinity change in the salt water pan. (Roberts-ISWS)
W80-06683

EVAPOTRANSPIRATION FROM VEGETATIVE SURFACES IN MAINE,
University of Maine at Orono, Dept. of Plant and Soil Sciences.
S. M. Goltz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-104903, Price codes: A05 in paper copy, A01 in microfiche. Land and Water Resources Center, University of Maine Completion Report, Technical Bulletin 97, June, 1980. 74 p, 26 Fig, 24 Tab, 19 Ref, 6 Append. OWRT-A-035-ME (1).

Descriptors: *Evapotranspiration, *Crops, *Equations, *Measurement, Blueberries, Potatoes, Evaporation, Transpiration, Maine, Soil moisture, Moisture tension, Heat budget, Energy budget, Mathematical studies, *Vegetable crops, Diurnal, Maine, Soil properties, Soil types, Crop production, Air temperature, Solar radiation.

Diurnal evapotranspiration (ET) measurements were made for lowbush blueberries and potatoes in Maine during selected portions of the 1977 and 1978 growing seasons. Half-hourly measurements were made using a Bowen ratio-energy budget method. These data provided the principal energy budget components, an evaluation of potential ET, and a variety of diagnostics used to evaluate the partitioning of available energy into sensible/latent heat. ET rarely attained potential values and large variability was found to exist. The Priestly and Taylor equilibrium evaporation equation was examined to attempt a reliable daily estimate of ET from potatoes using a minimum amount of the data. This equation was modified, to incorporating a soil moisture tension term to account for drying soil conditions, to predict daily ET rates. Reliable ET rates are essential to hydrologic planning, for evaluation of waste disposal methods, and for enhancing agricultural productivity. Half-hour means of dry bulb temperature and vapor pressure gradients over potatoes and blueberries are given in Appendix I; supplementary data tables and graphs for energy-balance Bowen ratio data, diagnostic data, and daily variation in selected diagnostics and ET data over potatoes at Presque Isle, in Appendices II-VI. (Zielinski-IPA)
W80-06707

EVAPOTRANSPIRATION STUDIES ON THEMEDA TRIANDRA FORSK. UNDER FIELD CONDITIONS (EVAPOTRANSPIRASIE-STUDIES OP THEMEDA TRIANDRA FORSK. ONDER VELDTOESTANDE),
Orange Free State Univ., Bloemfontein (South Africa).
D. P. J. Opperman, J. J. Human, and M. F. Viljoen.
Proceedings of the Grassland Society of Southern Africa (Pietermaritzburg), Vol 12, p 71-76, 1977. 4 Fig, 1 Tab, 19 Ref.

Descriptors: *Evapotranspiration, *Lysimeters, Evaporation, Water loss, *Grasslands, Climatology, Drying, Soil moisture, Transpiration loss, Water yield improvement, Depth, On-site investigations, Instrumentation, Semiarid climates, Arid climates, Rainfall, Moisture availability, Retention, Soil types, Seasonal, Available water, Moisture content, Mathematical studies, Computer programs, *South Africa, *Themeda trianda grass cover.

Over the period 1972-1975, hydraulic non-floating lysimeters were used to determine the evapotranspiration (Et) rates of a Themeda triandra grass cover under field conditions in South Africa. Water-balance models are essential to the understanding of soil moisture conditions in South Africa's semi-arid and arid regions. The highest Et losses were registered during December 1972/January 1973, February 1974, and March 1975 when the plants were in the reproductive phase. As much as 10.22 millimeters of water loss per day was recorded and the evaporation losses (Eo) from the bare soil lysimeters were about 67% of the value for grass covered lysimeters. The weekly Et/Eo ratios were averaged for the three seasons and compared to the rainfall data: 1972/73; Et/Eo=0.341; 252.2 mm rain; 1973/74; Et/Eo=0.389 (the potential under nonlimiting soil moisture conditions); 986.6 mm rain; and 1974/75; Et/Eo=0.334; 524.2 mm rain. A computer was used to fit a harmonic curve to the data taking into account the soil type and depth and the climatic conditions. The computed values provided a reasonable approximation to the observed data as measured by gravimetric methods and the data indicate that water is more efficiently used at lower moisture levels than at higher. (Sidney-IPA)
W80-06718

WATER DROPS AND PACKING EFFECTS INSIDE ATMOSPHERIC COOLING TOWERS,
Ecole Centrale de Lyon, Ecully (France). Lab. de Mecanique des Fluides.
J. F. Brison, M. Buffat, D. Jeandel, and P. Sonneville.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 7.55-7.63, 1980. 5 Fig, 8 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Finite element analysis, *Mathematical models, *Cooling towers, *Water cooling, Flow, Analytical techniques, Analysis, Flow characteristics, Model studies, Thermal powerplants, Nuclear powerplants, Drops(Fluids), Water, Cooling tower packing, Airflow.

Atmospheric coolers play an important role in the working of nuclear powerplants. One way of removing the heat excess from water is the natural draft counter-flow tower. Hot water disperses just above the packing, then streams down by gravity, forming a cloud of droplets. Consequently, as heat transfers from the water to the air, a natural draft is formed corresponding to the temperature increase in the gas convected upwards. The calculation for an air-droplet packing flow field was performed. The finite element method and least squares formulation of the Navier-Stokes problem, including air-droplet interaction and packing simulation, provides a framework from which the analysis of atmospheric coolers seems possible at a moderate Reynolds number. The results are satisfactory and open the way for further progress in the areas of three-dimensionality, and thermal and turbulence effects (the practical Reynolds number is 1,000,000). (See also W80-06894) (Humphreys-ISWS)
W80-06929

2E. Streamflow and Runoff

THE APRIL '79 FLOODS OF THE PEARL AND TOMBIGBEE RIVERS. APRIL 1979 - A REPORT TO THE ADMINISTRATOR.
National Oceanic and Atmospheric Administration, Rockville, MD.
NOAA Natural Disaster Survey Report 80-2, April 1980. 121 p. 5 Fig, 2 Tab, 3 Append.

Descriptors: *Floods, *Rivers, *Flood forecasting, Warning systems, Rainfall, Storms, Mississippi, Alabama, Flood data, Flood damage, Record flood event, *Pearl River, *Tombigbee River.

The large tornado-breeding storm system that severely damaged Wichita Falls, TX, and spread into Oklahoma on April 10, 1979, set off heavy rains as it moved into western Mississippi on Wednesday evening, April 11, and into Alabama the next morning. Flash floods occurred at many locations in Mississippi and Alabama, and later caused record flooding on the Noxubee, Tombigbee, Black Warrior, and Pearl Rivers. Flooding was occurring simultaneously in the entire area of the Lower Mississippi River Forecast Center, at Slidell, LA, with the Yazoo, Leaf, Chickasawhay, and Big Black River systems experiencing maximum floods of record. In general, the public forecast and warning statements were good and well-written. Most statements were rapidly and successfully disseminated despite a few teletypewriter problems. The NOAA-operated dissemination networks - NOAA Weather Radio and NOAA Weather Wire Service - functioned well and served as the principal channels for distribution of information to local officials and the general public. Many people were either not aware of their danger, or refused to believe the degree of danger. (NOAA)
W80-06454

THE PRESERVATION OF SKEWNESS IN LINEAR DISAGGREGATION SCHEMES,
Pisa Univ. (Italy). Ist. di Idraulica.
E. Todini.
Journal of Hydrology, Vol 47, No 3/4, p 199-214, July 1980. 1 Fig, 3 Tab, 11 Ref.

Descriptors: *Discharge(Water), *Streamflow, *Model studies, Mathematical models, Analytical techniques, Mathematics, Correlation analysis, Sta-

tistics, Statistical models, Statistical methods, Skewness, Disaggregation schemes.

Methods for the preservation of skewness in linear disaggregation schemes were reviewed and disadvantages of some recent approaches were identified. Methods were suggested whereby the preservation of skewness can be achieved theoretically, although in finite samples a bias is evident which is independent of the proposed methods. The application of the methods was illustrated through an example. (Sims-ISWS)
W80-06471

FLOW ESTIMATION IN AN UNSTABLE RIVER ILLUSTRATED ON THE RAKAIA RIVER FOR THE PERIOD 1958-1978,
Ministry of Works and Development, Christchurch (New Zealand). Water and Soil Science Centre.
For primary bibliographic entry see Field 2A.
W80-06477

PREDICTION OF HYDROLOGIC VARIABLES FROM CHANNEL MORPHOLOGY, SOUTH ISLAND RIVERS,
Forest Research Inst., Christchurch (New Zealand).
M. P. Mosley.
Journal of Hydrology (New Zealand), Vol 18, No 2, p 109-120, 1979. 1 Fig, 5 Tab, 17 Ref.

Descriptors: *Channel morphology, *Hydrology, *Flow characteristics, *Natural streams, Alluvial channels, Foreign research, Rivers, Foreign countries, Discharge(Water), Annual flood, Watersheds(Basins), Streamflow, Flood flow, Flood forecasting, Sediments, Variability, Hydrologic data, Flood recurrence interval, Hydraulics, Shape, Slopes, Width, Hydraulic radius, *New Zealand, *South Island(New Zealand), Bankfull discharge.

Data on the hydrology, sedimentology, and morphology of 73 alluvial channels in the South Island, New Zealand, were used to develop predictive equations for hydrologic parameters. Of ten indices of magnitude and variability of discharge, prediction equations for only mean annual flood, standard deviation of annual floods, and bankfull discharge could be developed that had acceptable precision. An equation for mean annual flood using channel cross-sectional area and aspect ratio (maximum depth/hydraulic radius) as predictive variables has a standard error of estimate lower than an equivalent equation for the whole South Island using other catchment and precipitation characteristics. Its precision is less than that of four regional equations using catchment and precipitation characteristics, but it avoids the problems of defining regions and could usefully be used in conjunction with these equations. Bankfull discharge is the only hydrologic parameter other than mean annual flood and the standard deviation of the annual floods that can be predicted from channel morphology. Channel morphology is evidently controlled primarily by flood flows (with recurrence intervals of 1 to 2 years) that fill the channel; lower flows (such as median discharge and mean discharge) are contained within the channel and do not modify or control its shape. Similarly, there appears to be little relationship between channel morphology and any simple index of discharge variability, so that the latter cannot be estimated from the former. Despite much recent interest in this aspect of river morphology, the influence of flow variability is evidently of minor importance relative to other controls on channel form. (Humphreys-ISWS)
W80-06478

THE NUMERICAL CALCULATION OF EXTREME WET AND DRY PERIODS IN HYDROLOGICAL TIME SERIES,
Technical Univ. of Istanbul (Turkey). Dept. of Hydraulics and Water Power.
For primary bibliographic entry see Field 2A.
W80-06481

NUMERICAL MODELLING OF SUSPENDED SEDIMENTS,
Thessaloniki Univ., Salonika (Greece). Dept. of Hydraulics.
For primary bibliographic entry see Field 2J.
W80-06485

SHIFTING LEVEL MODELLING OF HYDROLOGIC SERIES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W80-06486

THE NUMERICAL MODELLING OF STORM SURGES IN THE BAY OF BENGAL,
Reading Univ. (England). Dept. of Meteorology.
For primary bibliographic entry see Field 2L.
W80-06498

REPORT OF THE ANNUAL YIELD OF THE ARKANSAS RIVER BASIN FOR THE ARKANSAS RIVER BASIN COMPACT, ARKANSAS--OKLAHOMA, 1979 WATER YEAR,
Geological Survey, Little Rock, AR. Water Resources Div.
G. L. Ducret, Jr.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $3.50 in paper copy, $3.50 in microfiche. Geological Survey open-file report 80-333, 1980. 25 p, 1 Fig, 3 Tab, 3 Ref.

Descriptors: *Interstate compacts, *Interstate rivers, *Arkansas, *Oklahoma, *Streamflow, Flow rates, Gaging stations, Water yield, Runoff, Reservoir storage, *Arkansas River basin.

This report contains computed annual yields and deficiencies, of the subbasins as defined in the Arkansas River Compact, Arkansas-Oklahoma; actual runoff from the subbasins and depletion caused by major reservoirs, in the compact area; and monthly maximum, minimum, and mean discharges for the 14 streamflow stations used in computing annual yield. (USGS)
W80-06520

QUALITY OF WATER AND TIME OF TRAVEL IN HOBOLOCHITTO CREEK, PEARL RIVER COUNTY, MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 5B.
W80-06522

ANNUAL PEAK DISCHARGES FROM SMALL DRAINAGE AREAS IN MONTANA THROUGH SEPTEMBER 1979,
Geological Survey, Helena, MT. Water Resources Div.
R. J. Omang, C. Parrett, and J. A. Hull.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $16.00 in paper copy, $4.50 in microfiche. Geological Survey open-file report 80-340, March 1980. 112 p, 2 Fig.

Descriptors: *Annual peak discharge, *Small watersheds, *Montana, *Floods, *Flood frequency, Crest-stage gages, Streamflow, Flow rates, Hydrologic data, *Missouri River basin, *Columbia River basin.

Annual peak stage and discharge data have been collected and tabulated for crest-stage gaging sites in Montana. The crest-stage program was begun in July 1955 to investigate the magnitude and frequency of floods from small drainage areas. The program has expanded from 45 crest-stage gaging stations initially to 173 stations maintained in 1979. Data in the report are tabulated for the period of record. (USGS)
W80-06528

FLOOD OF AUGUST 27-28, 1977, WEST CACHE CREEK AND BLUE BEAVER CREEK, SOUTHWESTERN OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
R. K. Corley, and T. L. Huntzinger.
Geological Survey open-file report 79-256, August 1979. 1 Sheet, 6 Ref.

Descriptors: *Floods, *Oklahoma, *Storms, *Rainfall intensity, *Peak discharge, Flood frequency, Flood damage, Storm runoff, High water mark, Maps, Flood profiles, *Southwestern Oklahoma, *West Cache Creek(OK), *Blue Beaver Creek(OK).

This report documents a major storm which occurred August 27-28, 1977, in southwest Oklahoma near the communities of Cache and Faxon, OK. Blue Beaver Creek and West Cache Creek and their tributaries experienced extensive flooding that caused an estimated $1 million in damages. Reported rainfall amounts of 8 to 12 inches in 6 hours indicate the storm had a frequency in excess of the 100-year rainfall. Peak discharges on Blue Beaver Creek near Cache and West Cache Creek near Faxon were 13,500 cubic feet per second and 45,700 cubic feet per second respectively. The estimated flood frequency was in excess of 100 years on Blue Beaver Creek and in excess of 50 years on West Cache Creek. Unit runoff on small basins were in excess of 2000 cubic feet per second per square mile. Surveyed highwater marks were used to map the flooded area. (USGS)
W80-06530

DROUGHT-INDUCED PROBLEMS AND RESPONSES OF SMALL TOWNS AND RURAL WATER ENTITIES IN COLORADO: THE 1976-1978 DROUGHT,
Colorado Univ., Boulder. Dept. of Economics.
C. W. Howe, P. K. Alexander, J. A. Goldberg, S. Sertner, and H. P. Studer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-225378, Price codes: A05 in paper copy, A01 in microfiche. Colorado State University, Fort Collins, Colorado Water Resources Research Institute Completion Report No. 95, June 1980. 88 p, 11 Fig, 9 Tab, 19 Ref, 1 Append. OWRT A-045-COLO(1).

Descriptors: *Droughts, *Small watersheds, *Colorado, *Irrigation, State jurisdiction, Water rights, Hydrology, Irrigation practices, Farm management, Well drilling, Stress, Water shortage, Watershed management, Water management, Groundwater, Water conservation, *Drought impact, Rural areas, Small towns.

During the 1976-1978 drought, climate and hydrologic conditions varied significantly across the State of Colorado, with adjacent drainage basins often experiencing quite different conditions, thus emphasizing the importance of providing climatological information and assistance programs tailored to local areas (e.g., the water districts). Small towns experienced the intensification of long existing problems such as lack of adequate raw water; poor system performance and loss of produced water due to insufficient maintenance; and inadequate cost management and use of water revenues for general purposes. Towns responded by carrying out emergency repairs, drilling wells, adding water rights, renting farm water, restricting water use, installing meters, and increasing water prices. It is incidated that many effective counter-drought actions depend on local knowledge/initiative. Higher level (State and Federal) programs should be designed to stimulate local initiatives. Rural water entities, providing mostly irrigation water, suffered problems from early season over-irrigation, over-expanding covered acreage relative to the reliable water supply, and inflexible reservoir management. Partial solutions were by cooperative sharing of water/water rentals between farmers, which emphasized the importance of having flexible short/long-term water transfer capability between uses. While major opportunities exist for coupled management of surface and tributary groundwater supplies, State priority rights currently prevents such management. (Zielinski-IPA)
W80-06561

LOW-FLOW DATA AND FREQUENCY ANALYSIS OF STREAMS IN NEW YORK EXCLUDING NEW YORK CITY AND LONG ISLAND,

Geological Survey, Albany, NY. Water Resources Div.
B. B. Eissler.
New York State Department of Environmental Conservation Bulletin 74, 1979. 176 p, 2 Fig, 3 Plates, 3 Tab, 11 Ref.

Descriptors: *Low-flow frequency, *Streams, *Streamflow, *New York, *Base flow, Flow characteristics, Flow rates, Discharge(Water), Data Collections, Maps, Gaging stations, Sites.

Minimum average 7-day 2-year and 10-year discharges of 926 stream sites in New York excluding New York City and Long Island are listed. Also included are base-flow measurements at sites for which no statistics were computed. This report evaluates data collected before October 1975. Data are provided for gaging stations on 154 unregulated streams and 124 regulated streams, 648 low-flow partial-record stations, and 2,384 miscellaneous sites. All measurement-site locations are shown on maps. A short text explains the procedures used and the methods of calculation. (USGS)
W80-06588

USE OF THE STORM MODEL FOR ESTIMATING THE QUANTITY AND QUALITY OF RUNOFF FROM THE METROPOLITAN AREA OF HOUSTON, TEXAS,
Geological Survey, Austin, TX. Water Resources Div.; and Geological Survey, Bay St. Louis, MS. Water Resources Div.
For primary bibliographic entry see Field 5B.
W80-06594

HYDROLOGIC CHARACTERISTICS OF WISCONSIN'S WETLANDS AND THEIR INFLUENCE ON FLOODS, STREAM FLOW, AND SEDIMENT,
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 2I.
W80-06595

STREAMFLOW STATISTICAL SUMMARIES FOR COLORADO STREAMS THROUGH SEPTEMBER 30, 1975, VOLUME 1: MISSOURI RIVER, ARKANSAS RIVER, AND RIO GRANDE BASINS,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W80-06596

THE ROLE OF GROUND WATER IN STREAM DISCHARGES FROM TWO SMALL WETLAND CONTROLLED BASINS IN EASTERN MASSACHUSETTS,
Lowell Univ., MA. Dept. of Earth Sciences.
For primary bibliographic entry see Field 2F.
W80-06601

A NOTE OF THE PERFORMANCE OF A 82BR RADIOACTIVE TRACER IN THE RIVER SKERNE, ENGLAND,
Teesside Polytechnic, Middlesbrough (England). Dept. of Civil Engineering.
L. Hamill.
Journal of Hydrology, Vol 47, No 3/4, p 307-315, July 1980. 4 Fig, 1 Tab, 16 Ref.

Descriptors: *River flow, *Tracers, *On-site investigations, Radioisotopes, Bromine, Rivers, Flow, Velocity, Hydrology, *Path of pollutants, *England, *River Skerne(England), Dilution gaging.

82Br which has been described as an almost perfect water tracer, was used in a hydrological investigation of the River Skerne in County Durham. Under very testing conditions the tracer proved very reliable and anticipated adsorption losses were shown to be insignificant. (Sims-ISWS)
W80-06629

RESIDUE AND TILLAGE EFFECTS ON SCS RUNOFF CURVE NUMBERS,
Science and Education Administration, Beltsville, MD.
W. J. Rawls, C. A. Onstad, and H. H. Richardson.
Transactions of the American Society of Agricultural Engineers, Vol 23, No 2, p 357-361, March-April 1980. 5 Fig, 7 Tab, 22 Ref.

Descriptors: *Residual soils, *Soil conservation, *Runoff, *Cultivation, Crops, Conservation, Crop production, Watersheds(Basins), Mulching, Storage capacity, Soils, Soil types, *Residue effects, Runoff curve numbers, *Tillage effects, Soil Conservation Service, Conservation tillage, No-till practices, Small watersheds, Cropland.

The Soil Conservation Service has developed runoff curve numbers that take into account conservation tillage and no-till practices. Tillage and crop data were assembled from small watersheds and plots located across the United States under natural and simulated rainfall. There were not enough data to derive an equation for predicting how conservation tillage affected runoff. Data compiled from plots and small watersheds under simulated and natural rainfall for 531 events were used to develop graphs that can be used as practical guides for estimating the decrease in Soil Conservation Service runoff curve numbers due to a certain amount of residue on the ground or a certain percentage of the surface covered with residue. Separate guides were developed for corn and for medium residue crops such as wheat, oats, sorghum, and soybeans. (Roberts-ISWS)
W80-06672

APPLICATION OF THE USDAHL-74 HYDROLOGY MODEL TO GRASSLAND WATERSHEDS,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2A.
W80-06675

FIELD TESTS TO VERIFY EQUATIONS FOR PREDICTING LATERAL VELOCITY DISTRIBUTIONS IN RIVERS,
Washington Univ., Seattle. Dept. of Civil Engineering.
R. E. Nece, and R. P. Vilker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-103038, Price codes: A05 in paper copy, A01 in microfiche. Technical Report No 66, June 1980, 86 p, 8 Fig, 8 Tab, 14 Ref. OWRT-A-098-WASH (1), 14-34-0001-9051.

Descriptors: *Streamflow, *Flow rates, *Model studies, *Runoff forecasting, *Washington, Streams, Depth-area-duration analysis, Stage-discharge relations, Channel Morphology, Mannings equation, Cedar River(WA), Deschutes River(WA).

Three models proposed by Milhous for predicting the lateral distribution of depth-averaged velocities in rivers were tested. Each model requires a different level of input data; all, however, assume that the stage-discharge relationship is known at that river station where the velocities are to be predicted. Two of the models incorporate Manning's equation for uniform flow as applied to sub-elements of the stream cross-section, and the third applies the 'hydraulic geometry' concept to the sub-elements. Field studies were carried out in the Cedar River and the Deschutes River, in Western Washington. The experimental results apply to gravel bed rivers. Some modification in calculation procedure were suggested. The principal application of the models is in the quantitative evaluation of reaches of rivers as fish habitats.
W80-06689

FITTING LOG NORMAL DISTRIBUTIONS TO HYDROLOGIC DATA,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
J. R. Stedinger.
Water Resources Research, Vol 16, No 3, p 481-490, June 1980. 3 Fig, 11 Tab, 21 Ref, 1 Append. OWRT A-085-NY (1).

Descriptors: *Hydrologic data, *Analytical techniques, *Mathematical models, Model studies, Monte Carlo method, Stochastic processes, Curves, Data processing, Flow, Streamflow, Hydrology, Log Pearson type 3 distribution, *Streamflow forecasting, Log normal distributions, Fitting procedures.

The mean square error of estimation of selected quantities was used to evaluate the efficiency of alternative methods for fitting the two- and three-parameter log normal distributions. Monte Carlo results showed that use of maximum likelihood parameter estimation dominates other methods for fitting the two-parameter log normal distribution for samples of 25 or more log normal variates. For the three-parameter log normal distribution the standard moment method performed best for log normal distributions with low skew coefficients, while use of the sample mean, variance, and quantile estimate of the lower bound performed better for highly skewed log normal distributions; use of the unbiased standard deviation and skew coefficient was almost dominated by this new fitting procedure. The performance of the better fitting procedures was also evaluated when the observations were drawn from a log Pearson type 3 distribution. (Sims-ISWS)
W80-06753

FLOW-DRIVEN WATER QUALITY SIMULATION MODELS,
Severn-Trent Water Authority, Birmingham (England).
For primary bibliographic entry see Field 5B.
W80-06771

FLOOD OF APRIL 1977 IN THE APPALACHIAN REGION OF KENTUCKY, TENNESSEE, VIRGINIA, AND WEST VIRGINIA,
Geological Survey, Charleston, WV. Water Resources Div.
G. S. Runner, and E. H. Chin.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $3.50 in paper copy. Geological Survey Professional Paper 1098, 1980. 43 p, 27 Fig, 18 Tab, 6 Ref.

Descriptors: *Floods, *Cloudbursts, *Flood discharge, *Flood damage, *Appalachian Mountain Region, Meteorology, Flood recurrence interval, Streamflow, Peak discharge, Flood data, Hydrologic data, Stream gages, Flow rates, Hydrographs, Kentucky, Tennessee, Virginia, West Virginia.

Heavy rains fell over the Appalachian region of Kentucky, Tennessee, Virginia and West Virginia April 2-5, 1977, causing record flooding. Rainfall amounts of 4 to 15.5 inches were observed. The maximum amount of 15.5 inches occurred at Jolo, WV, in about 30 hours. This was more than twice the amount which would be expected for a 100-year recurrence-interval storm. Flood discharges along the upper Guyandotte River; Tug Fork and Levisa Fork in the Big Sandy River basin; Cumberland River; and Clinch River and Dowell River in the Tennessee River basin exceeded those previously known. Severe flooding also occurred along the Holston River and along the North Fork Kentucky River. Recurrence intervals of observed flood discharges were greater than 100-years at 29 streamflow measurement sites. Substantial reductions in peak stages and discharges on Levisa Fork, North Pound River, and Guyandotte River, attained as a result of reservoir storage, were reported by U.S. Army Corps of Engineers. Maximum daily suspended-sediment discharges on Guyandotte River near Baileysville, WV, and Tug Fork at Glenhayes, WV, were 54,800 tons/day and 290,000 tons/day, respectively, April 5, 1977. Twenty-two lives were lost and total property damage reportedly exceeded $400 million in the four-State area. (USGS)
W80-06795

OPEN CHANNEL FLOW WITH SUSPENDED SEDIMENTS,
Hokkaido Univ., Sapporo (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.

W80-06820

VISUALIZATION OF SEPARATION OVER SAND WAVES,
Technical Univ. of Istanbul (Turkey). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W80-06821

APPLICATION OF THE HEC-4 MONTHLY STREAM FLOW SIMULATION MODEL,
Ohio Dept. of Natural Resources, Columbus. Div. of Water.
N. R. Bhaskar, and E. E. Whitlatch, Jr.
Water Resources Bulletin, Vol 16, No 4, p 587-593, August 1980. 5 Fig, 5 Tab, 10 Ref.

Descriptors: *Streamflow, *Monthly, *Ohio, *Model studies, Mathematical models, Simulation analysis, Synthetic hydrology, Duration curves, Flow, Low flow, Rivers, Reservoirs, Reservoir operation, Safe yield, Watersheds(Basins), Hydrology, HEC-4 Model.

The HEC-4 monthly streamflow simulation model, developed by the Hydrologic Engineering Center, Davis, California, was used to extend the available historical streamflow records in the central Ohio area. The principal objective of this paper was to examine the effectiveness of the HEC-4 model in generating synthetic monthly flows. Important statistical parameters were evaluated in order to relate the statistical properties of the historical and generated flows. In doing so, it was observed that the mean, standard deviation, and skewness of the generated flows are consistently larger than the corresponding estimates based on historical flows. However, results showed that these statistics, as well as the lag-1 serial correlation, are generally well maintained by the generated sequences. The degree to which any statistical dissimilarities would be critical, from an engineering design point of view, was demonstrated by utilizing their low flow characteristics. Estimates of reservoir safe-yields, based on a nonsequential mass-curve analysis of the historical and generated low flows, indicated a nominal difference in this particular study. (Sims-ISWS)
W80-06849

APPLICATIONS OF BOUNDARY ELEMENTS IN WATER RESOURCES,
Southampton Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W80-06859

ANALYSIS OF A FINITE ELEMENT ALGORITHM FOR NUMERICAL PREDICTIONS IN WATER RESOURCES RESEARCH,
Tennessee Univ., Knoxville. Dept. of Engineering Science and Mechanics.
A. J. Baker, and M. O. Soliman.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 1.40-1.55, 1980, 8 Fig, 12 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Finite element analysis, *Algorithms, *Mathematical models, *Hydrodynamics, Analytical techniques, Analysis, Equations, Model studies, Theoretical analysis, Convection, Diffusion, Waves(Water), Turbulent boundary layers, Open channel flow, Forecasting, Water resources research, Wave propagation.

Numerical solution algorithm development, for the nonlinear partial differential equations governing multidimensional problems in fluid dynamics, has been historically based upon finite difference procedures. This paper highlighted pertinent results on assessment of accuracy, convergence, and utility of a finite element algorithm for application to prediction of fluid dynamics phenomena in water resources applications. The results presented illustrate the versatility of the developed algorithm for parametric studies in three-dimensional hydrodynamic transport. The diffusion and convection phenomena, inseparable in the physical simulation, can be individually analyzed using a sufficiently high order-accurate algorithm. The error produced using any consistent numerical algorithm is controllable with discretization refinement, but computer resource constraints place a severe limitation on number of solution nodes for three-dimensional flows. The cited examples employed 4913 node points, with the dependent variable, plus three velocity and three diffusion coefficients defined at each node, plus various geometry information. The computer CPU per time step was approximately 10 seconds on an IBM 360/195, and the core requirement was approximately 125,000 words. (See also W80-06858) (Humphreys-ISWS)
W80-06861

BOUNDARY METHODS IN WATER RESOURCES,
Universidad Nacional Autonoma de Mexico, Mexico City.
I. Herrera.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 1.56-1.71, 1980. 2 Fig, 33 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Water resources, *Mathematical models, *Hydrodynamics, *Finite element analysis, Analytical techniques, Laplaces equation, Reviews, Theoretical analysis, Mathematical studies, Flow, Equations, Boundary elements.

A brief review of boundary methods was presented. Emphasis was placed on alternatives to boundary integral equations. Different theoretical questions required to give a firm foundation to these procedures were discussed. Extensions to nonlinear problems were explained. Examples of application to fluid problems were included. Boundary methods are being used to treat many problems. When they are applicable, the size of the regions that need to be treated numerically can be reduced. (See also W80-06858) (Humphreys-ISWS)
W80-06862

A MACRO-TO-MICRO FINITE ELEMENT PROCEDURE FOR PRODUCING WATER PLANNING MODELS,
Montana State Univ., Bozeman. Dept. of Industrial Engineering and Computer Science.
For primary bibliographic entry see Field 6A.
W80-06876

A FINITE ELEMENT MODEL INCORPORATING CHARACTERISTICS FOR THE DIFFUSION-CONVECTION EQUATION,
British Columbia Univ., Vancouver.
For primary bibliographic entry see Field 5B.
W80-06886

FINITE ELEMENTS IN WATER RESOURCES, VOLUME 2,
For primary bibliographic entry see Field 2A.
W80-06894

FINITE ELEMENT COMPUTATION OF TURBULENT FLOWS,
California Univ., Davis. Dept. of Civil Engineering.
B. E. Larock, and D. R. Schamber.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 4.31-4.47, 1980. 5 Fig, 24 Ref. Science and Education Administration, New Orleans, LA. NSF ENG76-18846.

Descriptors: *Finite element analysis, *Mathematical models, *Turbulent flow, *Flow, Analytical techniques, Turbulence, Model studies, Energy dissipation, Diffusion, Theoretical analysis, Equations, Numerical analysis, Sedimentation, Settling basins.

This paper presented a finite element formulation that is applicable to turbulent flows that may include a substantial recirculation region; its use was illustrated by application to a complex tow-dimensional flow. The presentation concluded with some comments on near-term research needs in this field. After reviewing briefly the major alternatives in the mathematical modeling of turbulent flows, this paper combined the kinetic energy-dissipation turbulent flow model and a mean flow model in a Galerkin finite element model applicable to incompressible turbulent two-dimensional flows with recirculation. Application of this model to examination of flow and particle settling in a rectangular sedimentation basin was presented; this approach completely determines the nonuniform velocity field and also resolves much uncertainty about the choice of values for both the eddy viscosity and the turbulent transport coefficients for settling. (See also W80-06894) (Humphreys-ISWS)
W80-06897

ON THE ACCURACY OF FINITE ELEMENT SOLUTIONS OF NAVIER-STOKES EQUATIONS USING A VELOCITY-PRESSURE FORMULATION,
Georgia Inst. of Tech., Atlanta. School of Nuclear Engineering.
C. Bratianu, and S. N. Atluri.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 4.92-4.101, 1980. 4 Fig, 12 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Finite element analysis, *Mathematical models, *Flow characteristics, Analytical techniques, Methodology, Analysis, Velocity, Pressure, Flow, Approximation method, Constraints, Navier-Stokes equations.

The purpose of this paper was to investigate: (1) conditions under which over- or underconstrained discrete domains appear, (2) their influence upon the accuracy of problem solution, and (3) practical ways of improving finite element analysis of viscous incompressible fluid flows via a velocity-pressure formulation. Incorporating the continuity equation within the finite element analogue of the Navier-Stokes equations leads unconditionally to over- or underconstrained domains and as a consequence to inaccurate solutions. One way of overcoming this situation consists in performing a constraint analysis of the discrete domain--as shown by present research--and choosing that discretization which offers an alpha value closest to the optimum one (i.e., alpha optim = 0.5). The practical value of this analysis stems in choosing an adequate discretization without performing any numerical experiments which would otherwise imply a lot of effort and computational time. This paper shows that the isoparametric formulation yields good results only for systems with large number of elements. For systems with a small number of elements the isoparametric formulation fails; instead, mixed interpolation should be used with pressure interpolated at a lower degree, and with pressure nodes located at the vertices of finite elements. (See also W80-06894) (Humphreys-ISWS)
W80-06902

A FINITE ELEMENT SOLUTION FOR DEPTH-AVERAGED TWO-DIMENSIONAL NAVIER-STOKES EQUATIONS FOR FLOWS IN RIVERS AND CHANNELS,
Catholic Univ. of Leuven (Belgium). Dept. of Civil Engineering.
M. Thienpont, and J. Berlamont.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 5.28-5.36, 1980. 9 Fig, 6 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Finite element analysis, *River flow, *Estuaries, *Mathematical models, Open channel flow, Analytical techniques, Mathematical studies, Analysis, Methodology, Model studies, Laboratory tests, Approximation method, Equations, Numerical analysis, Navier-Stokes equations, Two-dimensional flow.

The purpose of the model presented was to calculate depth integrated flow fields in channels, rivers

and estuaries. Although the present calculations have been done only for rectangular channels in which the model seems to perform fairly well, the model may be easily generalized. The convergion is sped up sensitivily by imposing calculated velocity gradients on the solid boundaries after the first iteration. Also, the introduction of a quite simple approximation of the Reynolds stresses as the Prandtl-Von-Karman mixing length hypothesis for the elements on solid boundaries improves the results with respect to results obtained with constant value of E, the eddy and kinematic viscosity coefficient, in each element. (See also W80-06894) (Humphreys-ISWS)
W80-06905

FINITE ELEMENT MODEL FOR OPEN CHANNEL FLOW NEAR CRITICAL CONDITIONS,
Louisville Univ., KY.
N. D. Katopodes.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 5.37-5.46, 1980. 5 Fig, 4 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Finite element analysis, *Open channel flow, *Mathematical models, *Critical flow, Analytical techniques, Flow, Flood waves, Velocity, Profiles, Waves(Water), Surges, Supercritical flow, Boundaries(Surfaces), Methodology, Analysis, Approximation method.

Recently, increased attention has been focused on the finite element method in an effort to determine its applicability to convection dominated flows. The selection of appropriate basis and weighting functions is a subtle matter in fluid problems and especially in convection dominated flows. In this work a 4-node bilinear quadrilateral element was used for both depth and velocity. There are several points in the present model where more research is necessary. These include the use of bilinear elements, the oblique grid in the time direction, the ad hoc upwind scheme, and handling of the computation near wave fronts. Although the results are satisfactory, the method of characteristics presents a more natural means of computation for open channel flow. In such cases, it is advantageous to use a competitive finite element model, because it involves a fraction of the computational cost and programming effort. (See also W80-06894) (Humphreys-ISWS)
W80-06906

APPLICATION OF THE FINITE ELEMENT METHOD TO VERTICALLY STRATIFIED HYDRODYNAMIC FLOW AND WATER QUALITY,
Hydrologic Engineering Center, Davis, CA.
For primary bibliographic entry see Field 2H.
W80-06910

TIDAL COMPUTATION IN THE ELBE ESTUARY WITH A COUPLED FE MODEL,
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydromechanik.
For primary bibliographic entry see Field 2L.
W80-06914

TWO-DIMENSIONAL FINITE ELEMENT ANALYSIS OF THE HYDRAULIC EFFECT OF HIGHWAY BRIDGE FILLS IN A COMPLEX FLOOD PLAIN,
Geological Survey, NSTL Station, MS. Gulf Coast Hydroscience Center.
J. K. Lee.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol.), Mississippi University, Oxford, May 19-23, 1980. p 6.3-6.23, 1980. 10 Fig, 1 Tab, 9 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Finite element analysis, *Mathematical models, *Flood plains, *Highway effects, *Flood stages, *South Carolina, Hydraulic structures, Rivers, Flood profiles, Dikes, Flood discharge, River training, Velocity, Currents(Water), Analytical techniques, Analysis, Distribution patterns, *Congaree River(SC).

A two-dimensional finite element surface-water model developed by Norton and King was used to study the hydraulic effect of a proposed interstate highway crossing of the Congaree River near Columbia, South Carolina. Rapid expansion of the flood palin of the Congaree River upstream of the proposed highway crossing, an extensive dike system, and highly variable roughness combine to cause significant lateral velocities and variations in stage. The use of a two-dimensional finite element model to study the hydraulic effect of a bridge crossing yielded a more detailed evaluation of flow distribution and water-surface elevations than are obtained by one-dimensional step-back-water and conveyance techniques. The results of this study suggest that correct and effective application of this model requires considerably practical experience. For modeling flow on flood plains of highly variable roughness, the testing or development, or both, of other finite element approaches and comparison with the Norton-King model were suggested, with particular emphasis on the capability of the models to respond accurately to large topographic gradients and highly variable roughness. (See also W80-06894) (Humphreys-ISWS)
W80-06921

A FINITE ELEMENT WATERSHED MODEL TO PREDICT STORM HYDROGRAPHS, SEDIMENT EROSION AND TRANSPORT,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W80-06922

CONVECTIVE HEAT TRANSPORT IN MERGING FLOWS,
Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.
E. A. Thornton, and P. Dechaumphai.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 7.45-7.54, 1980. 6 Fig, 1 Tab, 4 Ref. Science and Education Administration, New Orleans, LA. NASA NSG 1321.

Descriptors: *Finite element analysis, *Mathematical models, *Water temperature, *Open channels, Convection, Flow, Fluctuations, Heat transfer, Boundary processes, Heated water, Model studies, Air-water interfaces, Analytical techniques, Analysis, Thermocline, Merging flow, Heat transport.

Conventional and upwind finite element solutions were studied for the one-dimensional convective diffusion equation modified for surface heat exchange. Finite element calculated temperatures were compared with analytical solutions for merging flows in which large temperature gradients can occur at the flow confluence. For diffusion dominated flow, conventional finite element calculated temperatures showed oscillations for crude meshes. With local mesh refinement the oscillations were eliminated, and conventional finite element calculated temperatures gave excellent agreement with analytical solutions with accuracy superior to upwind elements. For convection dominated flows, conventional finite element calculated temperatures displayed strong oscillations. Local mesh refinement did not eliminate nor improve the oscillatory solutions, but upwind finite element calculated temperatures gave excellent agreement with analytical solutions with small numerical diffusion and dispersion errors. (See also W80-06894) (Humphreys-ISWS)
W80-06928

THE MOVING INTERFACE PROBLEM WITH FINITE ELEMENTS,
Sydney Univ., (Australia). Dept. of Aeronautical Engineering.
For primary bibliographic entry see Field 2A.
W80-06930

INTERACTIVE FINITE ELEMENT MESH GENERATORS FOR FLOW SYSTEMS,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical and Environmental Engineering.
C. Kleinstreuer.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 7.99-7.110, 1980. 4 Fig, 35 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Finite element analysis, *Flow system, *Data processing, Analytical techniques, Analysis, River flow, Groundwater movement, Canals, Subsurface flow, Channel flow, Mesh generators.

Mathematical models of large and/or geometrically complex systems, as found in water resources engineering, are solved with appropriate numerical methods that require automized mesh generators since manual grid designing is time consuming and prone to error. The best methodology for developing mesh generators/data preprocessors depends upon the desired degree of generality: (1) preprocessors for a specific analysis program are simple, low-cost and efficient but inflexible; (2) preprocessors for a specific numerical model in which three modules function as a domain generator for a one-, two- or three-dimensional F.E. system, an attribute editor providing element types, system properties, boundary conditions for structure, heat transfer or fluid flow analysis, and an interface routine that prepares the geometric and attribute data for the main program; (3) preprocessors for the optimal analysis of a given problem in which the environmental/process data and the expected results are analyzed, and the best available numerical scheme with associated mesh generator is chosen. It was shown that mesh generators for a specific numerical scheme is cost-effective in solving large and/or complex problems. (See also W80-06894) (Humphreys-ISWS)
W80-06933

ELASTIC GRID DEFORMATION FOR MOVING BOUNDARY PROBLEMS IN TWO SPACE DIMENSIONS,
Thayer School of Engineering, Hanover, NH.
For primary bibliographic entry see Field 2F.
W80-06934

2F. Groundwater

THE ANALYSIS OF GROUNDWATER SEEPAGE IN HETEROGENEOUS AQUIFERS,
Rothamsted Experimental Station, Harpenden (England). Dept. of Physics.
E. G. Youngs.
Hydrological Sciences Bulletin, Vol 25, No 2, p 155-165, June 1980. 5 Fig, 14 Ref.

Descriptors: *Groundwater movement, *Aquifers, *Seepage, *Mathematical models, Theoretical analysis, Analytical techniques, Analysis, Darcys Law, Drainage, Water table, Drawdown, Infiltration, Potential flow, Aquifer characteristics, Groundwater mounds.

The solutions of groundwater problems in unconfined aquifers with non-uniform hydraulic conductivity often may be obtained simply without recourse to approximation by considering the horizontal seepage through the aquifer. This is done by defining a potential function. Examples were given of the use of the seepage analysis in the study of land drainage, well performance and groundwater-mound development. It was noted that the use of the Girinskii potential to obtain approximate solutions to groundwater problems gives in many situations fortuitously correct seepage rates, although incorrect water table heights. (Humphreys-ISWS)
W80-06483

A SURVEY OF HELIUM IN GROUNDWATER IN PARTS OF SABARMATI BASIN IN GUJARAT STATE AND IN THE JAISALMER DISTRICT, RAJASTHAN,
Physical Research Lab., Ahmedabad (India).

For primary bibliographic entry see Field 7C.
W80-06484

SELECTED WATER-LEVEL RECORDS FOR OKLAHOMA, 1976-78,
Geological Survey, Oklahoma City, OK. Water Resources Div.
R. L. Goemaat, and D. E. Spiser.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $7.00 in paper copy, $3.50 in microfiche. Geological Survey open-file report 79-1580, November 1979. 48 p, 1 Fig, 1 Tab.

Descriptors: *Oklahoma, *Water wells, *Water levels, Aquifers, *Groundwater, Water level fluctuations, Basic data collections.

A systematic program to collect water-level records in Oklahoma began in 1937. The objectives of this program are (1) to provide long-term records of water-level fluctuations in representative wells, (2) to facilitate the prediction of water-level trends and indicate future availability of ground-water supplies, and (3) to provide information for use in basic research. The report includes a table of annual ground-water-level measurements in 711 selected wells throughout Oklahoma. The data are subdivided by counties. (USGS)
W80-06515

APPRAISAL OF GROUND WATER IN THE VICINITY OF THE LEADVILLE DRAINAGE TUNNEL, LAKE COUNTY, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W80-06516

DIGITAL-MODEL PROJECTION OF SATURATED THICKNESS AND RECOVERABLE WATER IN THE OGALLALA AQUIFER, TEXAS COUNTY, OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
R. B. Morton.
Geological Survey open-file report 79-565, January 1980. 34 p, 12 Fig, 12 Plates, 17 Ref.

Descriptors: *Computer models, *Forecasting, *Groundwater availability, *Aquifers, *Oklahoma, Model studies, Zone of saturation, Aquifer characteristics, Reservoir storage, Groundwater resources, Water yield, Water levels, Groundwater recharge, Irrigation wells, Withdrawal, Hydrogeology, Maps, *Ogallala aquifer(OK), *Texas County(OK), Saturated thickness.

A digital model was used to provide a quantitative description of the Ogallala aquifer in Texas County, Oklahoma, and to predict saturated thickness and recoverable water from the aquifer at specified future times. The Ogallala aquifer, which consists of unconsolidated sand, gravel, and clay, is the principal source of ground water in Texas County. Saturated thickness ranged from 0 to over 600 feet. The estimated value used for specific yield in most of the areas was 0.15 but 0.05 was used in some places. Hydraulic conductivity ranged from 0 to more than 200 feet per day, and recharge ranged from 0.2 to 2.2 inches per year. Well discharge was estimated using crop acreage and estimate of irrigation requirements. For projection simulations with large stress, a reasonable maximum stress of 1 well per 160 acres, or 16 wells per node, discharging at 1971 pumping rates per node, if saturated thickness was more than 38 feet, was used. A constant flux (impermeable) boundary was used around most of the modeled area; however, a constant head boundary was used for a reach of the Cimarron River. A constant head boundary which may convert to an impermeable boundary, depending on the potentiometric gradient at the boundary, was used for Palo Duro Creek and a reach of Beaver River. (USGS)
W80-06521

GROUND-WATER RESOURCES AND GEOLOGY OF WASHINGTON AND OZAUKEE COUNTIES, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
H. L. Young, and W. G. Batten.
Wisconsin Geological and Natural History Survey Information Circular No 38, February 1980. 37 p, 18 Fig, 2 Plates, 3 Tab, 22 Ref.

Descriptors: *Groundwater resources, *Water yield, *Water quality, *Hydrologic data, *Wisconsin, Hydrogeology, Water supply, Water wells, Water utilization, Aquifer characteristics, Water table, Groundwater recharge, Hardness(water), Chemical analysis, *Washington County(WI), *Ozaukee County(WI).

Water from three principal aquifers supplies most water needs in Washington and Ozaukee Counties, WI. Wells generally yield 15 gallons per minute (gal/min) in these counties. The sand-and-gravel aquifer yields 500 to 1,000 gal/min in parts of Washington County. The Niagara aquifer yields 500 gal/min in most of Ozaukee and eastern Washington Counties. In eastern Mequon in Ozaukee County and parts of western Washington County, it yields less than 100 gal/min. The sandstone aquifer underlies both counties and generally yields more than 1,000 gal/min. However, yields are commonly less than 500 gal/min in southwestern Washington County where the aquifer is thin. Ground water in these counties is suitable for most uses, but is very hard. Most of the water is a calcium-magnesium bicarbonate type. However, some sodium or calcium sulfate waters occur in the Niagara and sandstone aquifers and has dissolved solids of 600 to 1,300 milligrams per liter and 2,500 milligrams per liter, respectively. About 16 million gallons of ground water was pumped daily in the counties in 1975, of which 57 percent was from the Niagara aquifer and 29 percent was from the sand-and-gravel aquifer. (USGS)
W80-06523

HYDROGEOLOGIC DATA FOR THE MISSISSIPPI EMBAYMENT OF SOUTHEASTERN MISSOURI,
Geological Survey, Rolla, MO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W80-06525

WATER-LEVEL RECORDS FOR THE NORTHERN HIGH PLAINS OF COLORADO, 1975-79,
Geological Survey, Lakewood, CO. Water Resources Div.
R. G. Borman.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $4.00 in paper copy, $3.50 in microfiche. Geological Survey open-file report 80-5, 1980. 28 p, 2 Fig, 1 Tab.

Descriptors: *Groundwater resources, *Water wells, *Water levels, *Water level fluctuations, *Aquifers, Colorado, *Northern High Plains(CO), Ogallala Formation, Irrigation wells.

Water-level measurements were made in 665 wells in January 1979 in the northern high plains of Colorado. Most of these wells were irrigation wells, but several stock and government-owned observation wells also were measured, especially in areas where there is little irrigation. Water-level measurements for the years 1975 to 1979 are given by county. (USGS)
W80-06526

SURFICIAL GEOLOGY OF PART OF ELLISBURG QUADRANGLE, OSWEGO COUNTY, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W80-06529

WATER-LEVEL RECORDS FOR THE NORTHERN HIGH PLAINS OF COLORADO, 1976-80,
Geological Survey, Lakewood, CO. Water Resources Div.
R. G. Borman.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $4.00 in paper copy, $3.50 in microfiche. Geological Survey open-file report 80-438, 1980. 29 p, 2 Fig, 1 Tab.

Descriptors: *Groundwater resources, *Water wells, *Water levels, Water level fluctuations, *Aquifers, Colorado, *Northern High Plains(CO), Ogallala Formation.

Water-level measurements were made in 670 wells in the winter of 1979-80 in the northern High Plains of Colorado. Most of these wells were irrigation wells, but several stock and government-owned observation wells also were measured, especially in areas where there is little irrigation. Measurements for the years 1976 to 1980 are given by county. (USGS)
W80-06578

MEASURING LOCAL SUBSIDENCE WITH EXTENSOMETERS IN THE BATON ROUGE AREA, LOUISIANA, 1975-79,
Geological Survey, Baton Rouge, LA. Water Resources Div.
C. D. Whiteman, Jr.
Louisiana Department of Public Works Water Resources Technical Report No 20, 1980. 18 p, 2 Fig, 2 Plates, 4 Tab, 5 Ref.

Descriptors: *Land subsidence, *Measurement, *Extensometers, *Louisiana, *Groundwater, Withdrawal, Water levels, Aquifer characteristics, Test wells, Compaction, Pore pressure, Cores, Observation wells, Pore water, Clay minerals, *Baton Rouge area(LA).

Water-level declines caused by pumping ground water in the Baton Rouge area, LA, have resulted in a local cone of land-surface subsidence. Subsidence of at least 1.26 feet occurred during the period 1935-76, and subsidence average 0.035 feet per year, 1964-76. Three extensometers operated since October 1975 near the center of local subsidence record compaction in three zones within a 3,000-foot section of alternating sand and clay. The deepest monitor probably records more than 90 percent of the total compaction that causes local subsidence. If so, subsidence from October 1975 to April 1979 has averaged less than 0.014 foot per year. Water levels of most aquifers in early 1979 are above the lowest levels reached in previous years, so little compaction is occurring. A slow decline in the water level of the 2,800-foot sand and adjustment of excess pore pressures in thick clays below a depth of about 900 feet are responsible for the compaction and local subsidence observed since late 1975. The clays of the area are predominantly montmorillonite and mixed-layer clays. Pore water in the clays is more mineralized than water in the major aquifers but does not appear to threaten significant contamination. (USGS)
W80-06581

DIGITAL MODEL OF THE PINEY POINT AQUIFER IN KENT COUNTY, DELAWARE,
Geological Survey, Trenton, NJ. Water Resources Div.
P. P. Leahy.
Delaware Geological Survey Report of Investigations No 29, June 1979. 80 p, 39 Fig, 6 Tab, 25 Ref, Append.

Descriptors: *Computer models, *Aquifers, *Delaware, *Model studies, *Aquifer characteristics, Water wells, Pumping, Drawdown, Water level fluctuations, Forecasting, Transmissivity, Storage coefficient, Data collections, *Piney Point aquifer(DE), *Kent County(DE).

A two-dimensional digital model was developed to simulate the effects of increased pumping on the Piney Point aquifer in Kent County, DE. The model represents 3,150 sq. mi. of the Delmarva Peninsula, but is designed to make the most accurate predictions in an area of interest, 380 sq. mi. of Kent County. The calibrated digital model was used to predict water-level declines as the aquifer responded to both changes in the distribution and increases in the quantity of pumping to the year 2000. The model was calibrated using pumpage

from 1970 to 1975. The calibration involved comparison of (1) nodal values of simulated and interpretive drawdowns, and (2) simulated and observed hydrographs. In the area of interest, the mean error and standard deviation between the simulated and interpretive drawdowns were 0.7 ft. and plus or minus 2.2 ft. Observed and simulated hydrographs agree. The transmissivity of the aquifer was found to range from 7,350 sq. ft./d near Lebanon, DE to zero at the boundaries of the aquifer. The vertical hydraulic conductivity of the confining bed ranges from 0.00003 to 0.00005 ft/d. Predictions show that: (1) Under the 1975 stress of 2.68 Mgal/d, water levels will stabilize at about 12 ft below the 1975 water level at the center of the drawdown cone near Dover; (2) combined city and county withdrawal plans will cause static water levels to decline to within 20 to 30 ft of the top of the aquifer by the year 2000; and (3) by spreading development of the aquifer southwest of Dover, a withdrawal of 5.5 Mgal/d will result in stabilized water levels of 50 to 60 ft below the 1975 level at the center of the Dover cone. (USGS).
W80-06583

AVAILABILITY OF GROUND WATER FOR IRRIGATION ON THE KEKAHA-MANA COASTAL PLAIN, ISLAND OF KAUAI, HAWAII,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 4B.
W80-06587

GROUND-WATER RESOURCES OF MORTON COUNTY, NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 4B.
W80-06590

GROUND WATER RESOURCES OF RAMSEY COUNTY, NORTH DAKOTA,
Geological Survey, Billings, MT. Water Resources Div.; and Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 4B.
W80-06591

GROUND-WATER DATA FOR SHERIDAN COUNTY, NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 4B.
W80-06592

PROBLEMS OF RATIONALLY DRAINING THE POLEYES MARSHES,
Akademiya Navuk BSSR, Minsk. Inst. of Experimental Botany.
For primary bibliographic entry see Field 4A.
W80-06600

THE ROLE OF GROUND WATER IN STREAM DISCHARGES FROM TWO SMALL WETLAND CONTROLLED BASINS IN EASTERN MASSACHUSETTS,
Lowell Univ., MA. Dept. of Earth Sciences.
A. L. O'Brien.
Ground Water, Vol 18, No 4, p 359-365, July-August 1980. 4 Fig, 21 Ref. OWRR WR B-012.

Descriptors: *Groundwater, *Streamflow, *Base flow, *Massachusetts, Rainfall, Storms, Precipitation(Atmospheric), Infiltration, Water levels, Runoff, Swamps, Wetlands, Hydrographs, Data processing, Analytical techniques, On-site investigations, Hydrology, *Surface-groundwater relationships.

Groundwater discharge was found to be the primary cause of flood peaks generated at two small wetland controlled basins in eastern Massachusetts. Within the wetlands, groundwater rises rapidly following precipitation and in near synchronization with stream levels indicating a close coupling between groundwater and the stream. Stream hydrographs were separated into baseflow and surface runoff by a dynamic technique that matches the hydrograph of an index well with the stream hydrograph to determine the moment of maximum groundwater discharge. Hydrograph analysis showed that for both wetlands, groundwater is the major component of all flood peaks and accounts for approximately 93% of the total annual discharge. (Sims-ISWS)
W80-06601

DETAILS OF HYDROCHEMICAL VARIATIONS IN FLOWING WELLS,
Birmingham Univ. (England). Dept. of Geological Sciences.
J. M. Marsh, and J. W. Lloyd.
Ground Water, Vol 18, No 4, p 366-373, July-August 1980. 5 Fig, 2 Tab, 7 Ref.

Descriptors: *Wells, *Water wells, *Water chemistry, Sampling, On-site investigations, Well casings, Chemical reactions, Aquifers, Artesian wells, Pumping, Chemicals, Metals, Trace elements, Hydrogen ion concentration, Oxidation-reduction potential, Water temperature, Electrical conductance, Chemistry, Groundwater.

Due to chemical reactions between steel casing and stored water in capped artesian wells, the pH, Eh, TDS, major and trace ion concentrations and saturation indices are significantly, but relatedly altered from their aquifer values. To obtain true aquifer water samples, either all the stored water is flushed from the well or a sampling tube is used to ensure that the water is taken from within the aquifer. Flushing time was calculated from well dimensions and was monitored best in the field by measuring temperature and electrical conductivity. This study was made of confined wells in fissured limestone, but the reactions that occurred are likely to be common to aquifers of different hydrogeology. (Sims-ISWS)
W80-06602

SIMULATION OF SALT-WATER INTERFACE MOTION,
GeoTrans, Inc., Reston, VA.
For primary bibliographic entry see Field 2L.
W80-06603

CONVECTIVE HEAT TRANSFER IN SELECTED GEOLOGIC SITUATIONS,
Utah Univ., Salt Lake City. Dept. of Geology and Geophysics.
K. Kilty, and D. S. Chapman.
Ground Water, Vol 18, No 4, p 386-394, July-August 1980. 8 Fig, 24 Ref. DOE 78-1701.a.6.4.3.

Descriptors: *Heat transfer, *Groundwater, *Groundwater movement, *Model studies, Mathematical models, Temperature, Water temperature, Thermal conductivity, Geology, Convection, Recharge, Natural recharge, Thermal water, Thermal springs, Resistivity, Aquifers.

There are many geological situations in which moving groundwater transfers a significant amount of heat. Yet, while convective heat transfer is a common phenomenon, it is very difficult to treat analytically. This paper described a simple model of convective heat transfer in porous materials and a numerical method of solving the model. The model was then applied to three diverse field situations: (1) a thermal anomaly on the Hartville uplift in eastern Wyoming; (2) a fault-controlled hydrothermal system near Monroe, Utah; and (3) the Luanshya copper mine in the Republic of Zambia. In each case, heat transfer by moving groundwater was shown to satisfactorily explain the observed thermal anomalies. The results indicated that in certain situations the effect of groundwater flow needs to be considered in making local and regional assessments of heat-flow data. Furthermore, temperature measurements are very useful in estimating aquifer recharge, particularly when thermal conductivity and structural information are available. (Sims-ISWS)
W80-06604

GROUND-WATER MODELING: NUMERICAL MODELS,
GeoTrans Inc., Reston, VA.
C. R. Faust, and J. W. Mercer.
Ground Water, Vol 18, No 4, p 395-409, July-August 1980. 12 Fig, 2 Tab, 43 Ref, 2 Append. EPA R-803713.

Descriptors: *Groundwater, *Model studies, *Mathematical models, *Numerical analysis, Reviews, Water levels, Pumping, Groundwater movement, Mathematics, Equations, Methodology, Analytical techniques.

Partial differential equations may be used to describe a large number of problems in groundwater hydrology. Without a solution, however, these equations are of little value. Only a simplified subset of the general equations can be solved by analytical means, and these often describe idealized situations that are limited in application. Numerical solution of these equations using high speed digital computers offers a logical alternative. (Sims-ISWS)
W80-06605

AREAL, VERTICAL, AND TEMPORAL DIFFERENCES IN GROUND WATER CHEMISTRY: I. INORGANIC CONSTITUENTS,
Nebraska Univ., Lincoln. Conservation and Survey Div.
For primary bibliographic entry see Field 5B.
W80-06617

AREAL, VERTICAL, AND TEMPORAL DIFFERENCES IN GROUND WATER CHEMISTRY: II. ORGANIC CONSTITUENTS,
Nebraska Univ., Lincoln. Conservation and Survey Div.
For primary bibliographic entry see Field 5B.
W80-06618

A PREDICTOR-CORRECTOR ALTERNATING-DIRECTION IMPLICIT METHOD FOR TWO-DIMENSIONAL UNSTEADY SATURATED-UNSATURATED FLOW IN POROUS MEDIA,
Munich Univ. (Germany, F. R.). Inst. fuer Numerische and Instrumentelle Mathematik.
U. Hornung, and W. Messing.
Journal of Hydrology, Vol 47, No 3/4, p 317-323, July 1980. 3 Fig, 1 Tab, 10 Ref.

Descriptors: *Flow, *Porous media, *Groundwater movement, *Model studies, Mathematical models, Saturated flow, Unsaturated flow, Hydraulic conductivity, Storage capacity, Moisture content, Soil water, Groundwater, Theoretical analysis, Analytical techniques.

A noniterative method for the numerical solution of the nonlinear Richards' differential equation in two space dimensions was introduced. A test example shows that this method is more efficient than Crank-Nicholson's scheme. (Sims-ISWS)
W80-06630

COMPARISON OF CALCULATED AND IN SITU MEASURED UNSATURATED HYDRAULIC CONDUCTIVITY,
Central Soil Salinity Research Inst., Karnal (India).
For primary bibliographic entry see Field 2G.
W80-06631

REGIONAL GROUNDWATER MOTION IN RESPONSE TO AN OSCILLATING WATER TABLE,
Inland Waters Directorate, Ottawa (Ontario).
A. Vandenberg.
Journal of Hydrology, Vol 47, No 3/4, p 333-348, July 1980. 7 Fig, 6 Ref, 2 Append.

Descriptors: *Groundwater movement, *Water table, *Fluctuations, *Model studies, Mathematical models, Equations, Theoretical analysis, Permeability, Groundwater, Aquifers, Basins, Watersheds(Basins), Hydrology.

A case was made for the use of simple models of groundwater flow emphasizing the salient regional characteristics of groundwater basins and relating

them to basin-wide features of groundwater flow. As an example, a simple formula for the 'natural basin yeild' as defined by Freeze was calculated from a model that was introduced by Toth. The Toth model was extended to take seasonal fluctuations of the water table into account; the type of response of the instantaneous head distribution in the basin due to elastic storage in the aquifer ranges from severe distortions of Toth's steady-state distribution to virtually no distortion. The type of response depends on two ratios that are easily calculated from the basin parameters. (Sims-ISWS)
W80-06632

EVALUATING HYDRODYNAMIC DISPERSION COEFFICIENTS,
Central Soil Salinity Research Inst., Karnal (India).
S. K. Gupta, R. K. Batta, and R. N. Pandey.
Journal of Hydrology, Vol 47, No 3/4, p 369-372, July 1980. 1 Fig, 1 Tab, 5 Ref.

Descriptors: *Dispersion, *Porous media, *Hydrodynamics, *Model studies, Mathematical models, Groundwater, Groundwater movement, Solutes, Equations, Analytical techniques, Evaluation, Hydrology, Hydrodynamic dispersion coefficients.

An improved procedure for evaluating the hydrodynamic dispersion coefficient using 'inverfc' was presented. The procedure utilized the major portions of the breakthrough curves rather than a point-value that may be prone to measurement errors. Deviations resulting from these errors were minimized by using this procedure. (Sims-ISWS)
W80-06634

CONFINED FLOW IN AQUIFER CONTAINING THIN LAYER,
Missouri Univ. Columbia, Dept. of Civil Engineering.
C. W. Lenau.
Journal of the Engineering Mechanics Division, American Society of Civil Engineers, Vol 106, No EM4, Proceedings Paper 15630, p 719-737, August 1980. 10 Fig, 1 Tab, 5 Ref, 2 Append.

Descriptors: *Aquifers, *Confined water, *Hydraulic structures, *Permeability, Soil properties, Stratification, Graphical methods, Equations, Flow, Darcys law, Theoretical analysis, Hydraulic conductivity, Boundaries(Surfaces), Groundwater, Discharge(Water), Seepage, Hand calculators.

Solutions were developed for the seepage discharge under a hydraulic structure resting on an aquifer which contains a single thin stratum of very high or very low permeability. These solutions were presented in the form of graphs and equations suitable for use with a hand calculator. (Visocky-ISWS)
W80-06678

A SURVEY OF FREE BOUNDARY VALUE PROBLEMS IN THE THEORY OF FLUID FLOW THROUGH POROUS MEDIA: VARIATIONAL INEQUALITY APPROACH--PART I,
California Univ., Santa Barbara. Dept. of Mechanical and Environmental Engineering.
J. C. Bruch, Jr.
Advances in Water Resources, Vol 3, No 2, p 65-80, June 1980. 11 Fig, 3 Tab, 63 Ref.

Descriptors: *Seepage, *Dams, *Free surfaces, *Mathematical models, *Boundaries(Surfaces), Numerical analysis, Theoretical analysis, Equations, Flow, Water table, Infiltration, Groundwater movement, *Porous media, Variational inequality solutions.

A survey was presented of work done using variational inequalities in solving free-boundary problems arising in the filtration of liquids through porous materials. In 1971 Baiocchi proposed this new method for solving such problems. This method proved effective not only from the purely theoretical point of view, that is, for proving the existence and uniqueness of a solution, but also from the point of view of yielding new, simple, and efficient numerical solution schemes. This new method was systematically and extensively developed by mathematicians at the Laboratory of Numerical Analysis at the National Research Centre in collaboration with the Institute of Hydraulics of the University of Pavia. The aim of this survey is to present the basic ideas of this method, its applications, and other problems to which various researchers have extended the method. Also, the paper was written in such a manner as to be understood by a more general audience other than mathematicians, who are the ones who have done the majority of work in this area. (Visocky-ISWS)
W80-06681

CONCEPTUAL MODELS OF INTERACTIONS OF MINING AND WATER RESOURCE SYSTEMS IN THE SOUTHEASTERN IDAHO PHOSPHATE FIELD,
Idaho Univ., Moscow. Water Resources Research Inst.
M. R. Cannon.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-106353, Price codes: A06 in paper copy, A01 in microfiche. Technical Report, March, 1980. 106 p, 16 Fig, 6 Tab, 34 Ref. OWRT-C-7651 (no 7253) (4), 14-34-0001-7253.

Descriptors: *Mathematical models, *Mining, *Mine drainage, *Theoretical analysis, *Groundwater, Idaho, Phosphorus compounds, Water resources, Flow system, Mine water, Base flow, Hydrogeology, Models, Idaho, Surface water, Environmental effects, Geology, Geologic investigations, Mine types, Mine sites.

Groundwater flow system theory and observed water resource systems relationships were used to develop conceptual models that identify mine sites water resource systems, and evaluate mine sites for potential hydrologic impacts and mining constraints. The models can be used for existing/proposed mine sites, and should yield highly reliable results when used as specified. The theory provides a theoretical basis for formulating conceptual models of water resource systems in the southeastern Idaho phosphate field, and demonstrates how environmental factors (geology, topography, hydraulic conductivity, and fluid potential) control groundwater flow. This study shows that relationships exist between topographic, geologic, and climatic factors, and flow system development. Hydrologic impact is related to the size/types of flow systems encountered at the mine site, and hydrologic limitations to mining depend principally on the size/types of flow systems intercepted by mine pits. The overall purpose of this study was to formulate conceptual models of water resource systems of the phosphate field that can be used to systematically identify water resource systems at mine sites and evaluate mine sites for potential hydrologic impacts. (Zielinski-IPA)
W80-06704

INTERACTIONS BETWEEN OPEN PIT MINING AND GROUNDWATER FLOW SYSTEMS AT THE EAST AREA OF THE GAY MINE, IDAHO,
Idaho Univ., Moscow. Water Resources Research Inst.
T. F. Corbet, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-106361, Price codes: A06 in paper copy, A01 in microfiche. Project Report, March, 1980. 100 p, 17 Fig, 8 Tab, 20 Ref, 6 Append. OWRT-C-7651 (no 7253) (3), 14-34-0001-7253.

Descriptors: *Groundwater, *Hydrogeology, *Mine drainage, *Mathematical models, Mining, Mine water, Mine wastes, Wells, Dewatering, *Water quality, Drainage systems, Idaho, Phosphorus compounds, Phosphate ore, Base flow, Water resources, Idaho, Water quality effects, Geologic investigations, Geologic formations, Surface waters, Environmental effects, Gay Mine(ID).

A hydrogeology study was made of the Gay Mine, which uses open pit mining of phosphate ore and is located approximately 30 miles northeast of Pocatello, Idaho. The study area has groundwater flow systems controlled principally by fault block structure, and mine pit flooding by groundwater has seriously hindered mining operations. A conceptual model of groundwater flow systems was used to predict/evaluate potential interactions at a proposed pit site. Hydrogeologic boundaries (folds and faults) place rock units of low hydraulic conductivity (Phosphoria formation) adjacent to high/moderate hydraulic conductivity units (Wells, Dinwoody, and Thaynes formations). A major groundwater flow system in the Wells formation is continuous throughout the portion of mine studied, while minor flow systems occur at higher elevations (Dinwoody and Thaynes formation) separated from the major flow system by the Phosphoria formation. Major/minor systems recharge is by precipitation on the mine area, with discharge by sub-surface flow to the northwest. Mining at the proposed pit side will intersect the major flow system (Wells formation) and a minor one (Dinwoody formation). Calculations indicate that dewatering wells can resolve these problems. Limited study indicated insignificant water quality degradation due to mine wastes leaching. (Zielinski-IPA)
W80-06705

POTENTIOMETRIC SURFACE MAP OF THE FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, MAY 1979,
Geological Survey, Orlando, FL. Water Resources Div.
For primary bibliographic entry see Field 7B.
W80-06785

DELINEATION OF GROUND-WATER CONTRIBUTING AREAS OF STREAMS OF SOUTHWEST SUFFOLK COUNTY, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
D. J. Sulam.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $1.00 in paper copy, $4.00 in microfiche. Geological Survey Open-File Report 80-346 (WRI), 1980. 4 p, 1 Fig, 1 Plate, 1 Ref.

Descriptors: *Groundwater, *Streams, *Hydrologic systems, *Surface-groundwater relationships, *New York, Groundwater movement, Flow system, Water table, *Suffolk County(NY), Long Island(NY), Groundwater divide.

The hydrologic system of southwest Suffolk County consists of two major components--a deep, southward-flowing ground-water system bounded on the north by Long Islands' regional groundwater divide and on the south by the south-shore bays and ocean, and an overlying series of shallow ground-water flow systems that are separated from one another by north-south-trending interstream water-table divides. The shallow flow systems are the source of base flow to all streams on the island. The ground-water-contributing areas of southwest Suffolk County's 21 streams are delineated on a map. The drainage-divide locations were derived from a 1975 water-table map on the assumption that flow in the shallow flow systems is two dimensional (horizontal). This assumption is valid for the southern part of the area (adjacent to flowing streams), but, because the direction of flow in the northern part, near the regional ground-water divide, is mainly downward, the delineations for the northern part are only inferred. (USGS)
W80-06786

SIMULATED EFFECTS OF GROUND-WATER DEVELOPMENT ON POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER, WEST-CENTRAL FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 6A.
W80-06787

GROUND-WATER DATA FOR GEORGIA, 1979,
Geological Survey, Doraville, GA. Water Resources Div.

S. E. Matthews, W. G. Hester, and M. P. O'Byrne.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $13.00 in paper copy, $3.50 in microfiche. Geological Survey open-file report 80-501, 1980. 93 p, 19 Ref.

Descriptors: *Groundwater resources, *Water levels, *Observation wells, *Water quality, *Georgia, Aquifers, Withdrawal, Water level fluctuations, Groundwater availability, Water supply, Groundwater recharge, Water utilization, Well data, Hydrographs, Hydrologic data, Hydrogeology.

Mean water levels in wells across Georgia were from 3.03 feet higher to 11.67 feet lower in 1979 than in 1978, and in some areas were the lowest on record. Water levels in the principal artesian aquifer underwent a long-term decline during the period 1970-79. In some areas water levels dropped more than 10 feet. Wells tapping the Clayton Limestone in the Albany area showed a long-term decline during the period 1970-79, and in some wells water levels dropped more than 20 feet. Water levels in the Cretaceous aquifer system showed little fluctuation during 1979. In the Piedmont area mean water levels remained the same to 4 feet higher in 1979 than in 1978 and showed no long-term trend. (USGS)
W80-06788

GROUND-WATER LEVELS IN ALLUVIUM ON THE SOUTH COAST OF PUERTO RICO, FEBRUARY 1978,
Geological Survey, San Juan, PR. Water Resources Div.
J. R. Diaz.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $2.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 79-1272, 1979. 18 p, 3 Fig, 10 Ref.

Descriptors: *Groundwater, *Water levels, *Aquifers, *Puerto Rico, *Salinty, Measurement, Water level fluctuations, Pumping, Water supply, Irrigation wells, Observation wells, Sampling, Hydrographs, *Caribbean area.

Ground-water levels in the alluvial aquifer of the south coast of Puerto Rico in February 1978 were similar to or slightly higher than those of February 1977. Water levels rose about 2 to 3 meters in the northern section near the foothills in the coastal plain area from Salinas to Patillas and in the Guanica-Penuelas area. Pumpage remained unchanged in most of the areas under study. Pumping-water levels were above mean sea level in all industrial well fields. Pumping and static water levels were below mean sea level (1 to 3 meters), in public supply and irrigation wells in the areas of Playa de Ponce, Descalabrado-Punta Petrona, and in the vicinity of the town of Salinas. These levels are considered to be normal for the dry season in these highly irrigated areas. Sixty-four water samples collected from irrigation, industrial and salinity observation wells exhibited similar or lower chloride concentration than in previous years. The average chloride concentration for 1978 was 57 milligrams per liter. (USGS)
W80-06794

A COMPUTER PROGRAM FOR SIMULATING GEOHYDROLOGIC SYSTEMS IN THREE DIMENSIONS,
Geological Survey, Albuquerque, NM. Water Resources Div.
D. R. Posson, G. A. Hearne, J. V. Tracy, and P. F. Frenzel.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225, $104.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-421, March 1980. 795 p, 19 Fig, 18 Tab, 20 Ref, 8 Append.

Descriptors: *Computer programs, *Simulation analysis, *Groundwater movement, *Hydrology, Saturated flow, Aquifers, Water table, Permeability, Equations, Numerical analysis, Data processing, Methodology, Computer models, *Strongly implicit procedure, *FORTRAN, *Three dimensions.

This document is directed toward individuals who wish to use a computer program to simulate ground-water flow in three dimensions. The strongly implicit procedure (SIP) numerical method is used to solve the set of simultaneous equations. New data processing techniques and program input and output options are emphasized. The quifer system to be modeled may be heterogeneous and anisotropic, and may include both artesian and water-table conditions. Systems which consist of well defined alternating layers of highly permeable and poorly permeable material may be represented by a sequence of equations for two dimensional flow in each of the highly permeable units. Boundaries where head or flux is user-specified may be irregularly shaped. The program also allows the user to represent streams as limited-source boundaries when the streamflow is small in relation to the hydraulic stress on the system. The data-processing techniques relating to 'cube' input and output, to swapping of layers, to restarting of simulation, to free-format NAMELIST input, to the details of each sub-routine's logic, and to the overlay program structure are discussed. The program is capable of processing large models that might overflow computer memories with conventional programs. Detailed instructions for selecting program options, for initializing the data arrays, for defining 'cube' output lists and maps, and for plotting hydrographs of calculated and observed heads and/or drawdowns are provided. Output may be restricted to those nodes of particular interest, thereby reducing the volumes of printout for modelers, which may be critical when working at remote terminals. 'Cube' input commands allow the modeler to set aquifer parameters and initialize the model with very few input records. Appendixes provide instructions to compile the program, definitions and cross-references for program variables, summary of the FLECS structured FORTRAN programming language, listings of the FLECS and FORTRAN source code, and samples of input and output for example simulations. (USGS)
W80-06800

BASIC ELEMENTS OF GROUND-WATER HYDROLOGY WITH REFERENCE TO CONDITIONS IN NORTH CAROLINA,
Geological Survey, Raleigh, NC. Water Resources Div.
R. C. Heath.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $12.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-44 (WRI), 1980. 86 p, 14 Ref.

Descriptors: *Groundwater, *Hydrogeology, *Water supply, *Groundwater resources, *North Carolina, Aquifers, Specific yield, Hydraulic conductivity, Transmissivity, Storage coefficient, Specific capacity, Potentiometric levels, Water table.

This report was prepared as an aid to developing a better understanding of the groundwater resources of North Carolina. It consists of 46 essays grouped into five parts. The topics covered by these essays range from the most basic aspects of ground-water hydrology to the identification and correction of problems that affect the operation of supply wells. The essays were designed both for self study and for use in workshops on ground-water hydrology and the development and operation of groundwater supplies. From the standpoint of self study, it is assumed that the reader does not have any prior knowledge of geology or ground-water hydrology. Those readers with such knowledge can simply skip those topics with which they are already familar. (USGS)
W80-06801

RESULTS OF HYDRAULIC TESTS IN WELLS DOE-1, 2, AND 3, SALT VALLEY, GRAND COUNTY, UTAH,
Geological Survey, Denver, CO. Water Resources Div.
F. E. Rush, I. M. Hart, M. S. Whitfield, T. F. Giles, and T. E. D'Epagnier.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $5.25 in paper copy, $4.00 in microfiche. Geological Survey Open-File Report 80-205, 1980. 34 p, 15 Fig, 1 Plate, 8 Tab, 14 Ref.

Descriptors: *Test wells, *Groundwater, *Saline water, *Hydraulic conductivity, *Utah, Hydrogeology, Aquifer characteristics, Pumping, Water levels, Flow rates, Transmissivity, Chemical analysis, *Grand County(UT), *Salt Valley anticline, Dating, Carbon-14.

Three exploratory wells were drilled for geological, geophysical, and hydrological purposes in Salt Valley, Grand County, UT. Cap rock, salt, and interbeds of the Paradox Member of the Hermosa Formation of Middle Pennsylvanian age were penetrated. The observed depth below land surface of the cap rock-salt interface ranges from 163 to 191 meters. Approximately the upper 100 meters of cap rock were unsaturated by ground water. Within the saturated part of the cap rock, hydraulic heads generally decrease with depth and southwestward. Ion concentrations generally increase with depth in the saturated cap rock. Hydraulic conductivity of cap rock, as determined from pumping tests, may be on the order of 0.005 meter per day; as a result, ground-water flow rates in the cap rock are probably very low. A carbon-14 specific activity for cap rock water yielded an uncorrected 'age' of greater than 36,000 years. Salt and interbeds have hydraulic conductivities probably less than 0.0001 meter per day. (USGS)
W80-06802

MAP OF INDIAN WELLS VALLEY, CALIFORNIA, SHOWING CHANGE IN WATER LEVEL, 1963-78, AND HYDROGRAPHS OF SELECTED WELLS,
Geological Survey, Laguna Niguel, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W80-06803

STOCHASTIC MODEL OF WATER TABLE UNDER DRAINAGE,
Dames and Moore, Los Angeles, CA. Advanced Technology Group.
B. Sagar, and C. Preller.
Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol 106, No IR3, Proceedings Paper 15673, p 189-202, September 1980. 3 Fig, 17 Ref, 5 Append.

Descriptors: *Groundwater, *Water table, *Drainage, *Model studies, Mathematical models, Stochastic processes, Probability, Theoretical analysis, Flow, Recharge, Natural recharge, Soil water, Soil water movement, Hydrology, Boundary value problems.

A method for obtaining the water table fluctuations under drain boundaries and with stochastic net recharge was presented. The net recharge was the algebraic sum of intermittent additions through vertical seepage and continuous abtraction through evapotranspiration. A solution to the linearized Boussinesq's equation with net recharge as described above was obtained in a series form, from which the expected value and the standard deviation of water table height was then calculated. (Sims-ISWS)
W80-06826

UNSTEADY DRAWDOWN IN 2-D WATER TABLE AQUIFER,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2A.
W80-06828

PERSPECTIVE ON A MODIFIED CONJUGATE GRADIENT METHOD FOR THE FINITE ELEMENT SOLUTION OF LINEAR SUBSURFACE EQUATIONS,
IBM Italy Scientific Center, Rome.
G. Gambolati.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol.), Mississippi University, Oxford, May 19-23, 1980. p 2.15-2.30, 1980. 8 Fig, 9 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Groundwater, *Soil water, *Subsurface flow, *Model studies, Mathematical models, Theoretical analysis, Analytical techniques, Groundwater movement, Soil water movement, Equations, Mathematics, Matrices, Gradient Methods.

Modeling of subsurface flow relies upon the numerical solution of the diffusion equation. The analysis of regional flow involves the use of networks with many nodes and hence requires the final solution of an equivalent linear algebraic problem with a large number of unknowns. These unknowns are the values of the potential head on a set of nodes belonging to the flow region and specified 'a priori'. Recently a new semi-iterative approach based on a modified conjugate gradient (MCG) has been developed and applied to solve finite difference and finite element equations. In this paper a short review and an account of the properties of the gradient methods was provided using a geometric interpretation. It was proven that for structured band matrices MCG may still be quickly convergent irrespective of the diagonal dominance of A, and that MCG turns out to be very useful to refine the solution to ill-conditioned systems obtained with direct solution methods. (See also W80-06858) (Sims-ISWS)
W80-06864

FINITE ELEMENT MODELS FOR UNSATURATED GROUNDWATER ZONES,
Resource Management Associates, Lafayette, CA.
I. P. King.
In: Finite Elements in Water Resources, Vol 1; Preprints of the Third International Conference (2 Vol), MS Univ., Oxford, May 19-23, 1980. p 2.31-2.44, 1980. 4 Fig, 3 Tab, 6 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Groundwater, *Groundwater movement, *Model studies, *Finite element analysis, Mathematical models,Theoretical analysis, Computer models, Unsaturated flow, Infiltration, Soil water, Soil water movement, Flow, Vadose water, Hydrology.

The modeling of unsaturated groundwater zones has received increased attention in recent years. As the Environmental Protection Agency and other authorities have recognized the potential hazards from uncontrolled dumping, tracing of toxic contaminants is becoming a major concern. A similar concern has developed for study of leakage of low level radioactive material from tanks that have outlived their design life. The purpose of this paper was to review a number of models for vadose zone modeling and discuss computational aspects. It appears that the technology is in hand to simulate most of the highly nonlinear problems in this area. However, computer time is a significant problem when actual field simulations are required, particularly as long time simulations are necessary. (See also W80-06858) (Sims-ISWS)
W80-06865

NON-LINEAR GROUNDWATER FLOW SIMULATION,
Soil Mechanics Lab., Delft (The Netherlands).
F. B. J. Barends.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol.), Mississippi University, Oxford, May 19-23, 1980. p 2.56-2.65, 1980. 4 Fig, 6 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Groundwater movement, *Seepage, *Model studies, Mathematical models, Finite element analysis, Porosity, Hydraulic conductivity, Drag, Reynolds number, Wells, Water wells, Dikes, Groundwater, Soil water, Soil water movement, Nonlinear flow.

The transport process of water through a porous soil is governed by a relationship between the flux and the pressure gradient. Nonlinear effects arise at low gradients (clayey soils) and at high fluxes (coarse gravel beds). A linearization technique was suggested to incorporate these effects. Another phenomenon in porous flow is geometric nonlinearity in the form of moving boundaries (phreatic surface). Phreatic storage can be important, particularly for transient problems. The mathematical formulation of the free surface behavior was extended, and the numerical treatment of transient free surface problems was discussed with the emphasis on stability and accuracy. A third aspect is nonlinearity in the general equation of motion of pore fluids in aquifers, which can completely be included by a quite simple transformation, whereas the governing equation of motion is still Laplacian but now with respect to the exponential of the piezometric head multiplied by the sol-called coefficient of nonlinearity. (See also W80-06858) (Sims-ISWS)
W80-06868

ADJOINT-STATE FINITE ELEMENT EQUATIONS FOR PARAMETER ESTIMATION,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
S. P. Neuman.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol.), Mississippi University, Oxford, May 19-23, 1980. p 2.66-2.75, 1980. 3 Ref, 2 Append. Science and Education Administration, New Orleans, LA.

Descriptors: *Groundwater, *Diffusion, *Groundwater movement, *Model studies, Mathematical models, Equations, Mathematics, Finite element analysis, Theoretical analysis, Simulation analysis, Hydraulic conductivity, Pressure head, Storage capacity, Hydrology.

This paper was concerned with the problem of estimating the parameter function in the diffusion-type equation subject to the initial and boundary conditions. The finite element equations developed in this paper reduce to simpler forms which are valid under conditions of steady state. These steady state equations have been used in conjuction with a statistical parameter estimation procedure to determine the transmissivities of a hypothetical aquifer and are being currently used to determine the transmissivities of the Cortaro Aquifer in southern Arizona. (See also W80-06858) (Sims-ISWS)
W80-06869

ESTIMATION OF THE DIFFUSIVITY DISTRIBUTION IN AN INHOMOGENEOUS AQUIFER,
Osmania Univ., Warangal (India). Regional Engineering Coll.
P. Sreenivasulu, and B. S. Rama Rao.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol.), Mississippi University, Oxford, May 19-23, 1980. p 2.76-2.85, 1980. 1 Fig, 1 Tab, 3 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Groundwater, *Aquifers, *Diffusion, *Model studies, Transmissivity, Storage, Pumping, Drawdown, Finite element analysis, Theoretical analysis, Equations, Algorithms, Hydrology.

The solution for the drawdown distribution in an aquifer given the aquifer parameters, storativity and transmissivity, is straightforward and is called a 'direct problem'. The problem of estimating the distribution of aquifer parameters, based on a record of the drawdowns in different observation wells in a pumping test, is a complicated problem and is called an 'inverse problem'. Sreenivasulu and Labadie have presented an exhaustive review of the earlier contributions. The present work was another attempt in this direction drawing its inspiration from Newton-Raphson's method for solution of equations. (See also W80-06858) (Sims-ISWS)
W80-06870

NUMERICAL ANALYSIS OF MULTIPLE LEAKY AQUIFERS FOR LARGE VALUES OF TIME,
Universidad Autonoma Metropolitana, Iztapalapa, Mexico City. Dept. de Ingenieria.
L. R. Rodarte.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol.), Mississippi University, Oxford, May 19-23, 1980. p 2.86-2.95, 1980. 3 Fig, 11 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Groundwater movement, *Aquifers, *Groundwater, *Model studies, Mathematical models, Finite element analysis, Theoretical analysis, Equations, Permeability, Hydraulic conductivity, Pressure head, Hydrology, Leaky aquifers, Multiple leaky aquifers.

The multiple leaky aquifers analysis for the solution of problems related to regional studies is normally executed by modeling them in a computer. The resolution of the exact differential equations is inconvenient: it does not correspond to the existing field data quality, so it became advantageous to model approximate differential equations. Given the complexity of the analysis of multiple leaky aquifers, within the elastic theory some hypotheses have been used to simplify the mathematical formulation of the problem. In this work, the differential equations proposed by Herrera for the multiple leaky aquifers system analysis for large values of operation time were analyzed by means of the finite element method. It was concluded that the application of the finite element method to the analysis of multiple leaky aquifers permits one to obtain acceptable results with the precision required for this type of problem. (See also W80-06858) (Sims-ISWS)
W80-06871

A KRINGING-FINITE ELEMENT ITERATIVE MODEL FOR THE EVALUATION OF AQUIFER CHARACTERISTICS,
Agbabian Associates, Segundo, Ca.
B. A. Dendrou, S. A. Dendrou, and T. S. Papatheodorou.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 2.96-2.110, 1980. 9 Fig, 2 Tab, 6 Ref, 1 Append. Science and Education Administration, New Orleans, LA.

Descriptors: *Aquifer characteristics, *Model studies, *Mathematical models, *Finite element analysis, Numerical analysis, Analytical techniques, Equations, Groundwater, Groundwater movement, Aquifers, Hydraulic conductivity, Pressure head, Wells, Water wells, Water levels, Hydrology.

At the present time it can be safely said that the capability of the finite element approach to simulate phenomena governed by partial differential equations has brought 'numerical' errors within desirable bounds. By some accounts it is believed that the modeling precision has outgrown our present capability to provide accurate data, the acquisition of which is associated with high field operations and management costs. In this regard the need has been sensed for a direct association between the level of accuracy of the simulated state-variable response and the accuracy of the required data. An iterative procedure was developed and applied in a hypothetical groundwater aquifer exploitation problem. The intention was to identify invariants in an aquifer that could be used for an unbiased characterization of a site for a possible future exploitation. More than a mere enhancement of the analytic capability, the proposed model provides an effective means to improve the decision-making process, both in terms of accuracy and reliability in the decision, and in terms of an effective control of the associated costs involved in reaching that decision. (See also W80-06858) (Sims-ISWS)
W80-06872

DARCY AND FORCHHEIMER FLOWS TOWARDS WELLS WITH STORAGE IN CONFINED AND SEMI-CONFINED AQUIFERS,
Indian Inst. of Tech., Kharagpur (India). Dept. of Civil Engineering.
B. S. Rama Rao.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23,

1980. p 2.111-2.126, 1980. 5 Fig, 4 Tab, 9 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Aquifer characteristics, *Mathematical models, *Finite element analysis, *Groundwater movement, Aquifers, Darcys law, Water wells, Underground storage, Model studies, Analytical techniques, Analysis, Drawdown, Hydrogeology, Water table, Hydraulic conductivity, Mathematical studies, Forchheimer flows, Matrices.

This paper presented the results of an extensive study of flow towards wells with storage. The well-aquifer system was simulated by a finite element model. The study included confined and semi-confined aquifers, fully penetrating and partially screened wells, and Darcy (linear) and Forchheimer (nonlinear) flow conditions. Different combinations of aquifers, wells, and the flow conditions were simulated. The time at which the effect of well storage on the drawdowns becomes insignificant can be obtained from the tables presented. For all observations taken before such time, the type curves considering the well storage have to be used in the estimation of the aquifer storativity and transmissivity. These parameters may be roughly evaluated by the curve matching methods. Using them as initial guess values, the finite element models developed can be implemented on a digital computer. The drawdown history, so simulated, can be compared to the observed drawdown history, and the parameters can be adjusted by an iterative procedure to minimize the deviations between the observed and the simulated drawdowns, based on an appropriate error norm. This leads one to a special problem of parameter estimation. (See also W80-06858) (Humphreys-ISWS)
W80-06873

FINITE ELEMENT SOLUTIONS FOR UNCONFINED AQUIFER POLLUTION FROM SURFACE RECHARGE,
James Cook Univ. of North Queensland, Townsville (Australia).
For primary bibliographic entry see Field 5B.
W80-06874

AN EXPANDED SOLUTE TRANSPORT MODEL FOR SIMULATING GROUNDWATER CONTAMINATION EPISODES,
Notre Dame Univ., IN. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W80-06875

BEHAVIOR OF SEAWATER INTRUSION IN LAYERED COASTAL AQUIFERS,
Kobe Univ. (Japan). Faculty of Engineering.
For primary bibliographic entry see Field 2L.
W80-06879

COASTAL SEAWATER INTRUSION: A MOVING BOUNDARY PROBLEM,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2L.
W80-06880

SIMULATION OF THE TRANSIENT POSITION OF THE SALTWATER INTRUSION IN THE COASTAL AQUIFER NEAR MADRAS COAST,
Technische Hochschule, Aachen (Germany, F.R.).
For primary bibliographic entry see Field 2L.
W80-06881

FINITE ELEMENT METHOD IN SOLVING SOME UNUSUAL PROBLEMS OF INFILTRATION IN POROUS MEDIA,
Polytechnical Inst. of Bucharest (Rumania). Dept. of Hydraulics.
J. Florea, I. Seteanu, and R. Popa.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 2.239-2.248, 1980. 8 Fig, 3 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Infiltration, *Seepage, *Porous media, *Model studies, Mathematical models, Finite element analysis, Numerical analysis, Simulation analysis, Analytical techniques, Dams, Dikes, Groundwater movement, Groundwater, Drawdown, Soil water.

The use of the finite differences method proves to be difficult in solving some problems of infiltration, especially when the flow domain is initially unkown and the actual shape of the free surface (water table) is to be derived only after the computational iterative process is finished. Similarly, the seepage discharge prediction from an aquifer through the dock walls during construction stage, by taking into consideration the capillary pressure effect in the separation zone between saturated and unsaturated domains, proves the finite element method to be more suitable for solving the abovementioned problems. For determining the groundwater table drawdown because of dock drainage, the proposed mathematical model consists of a succession of two-dimensional boundary-value problems on a time-variable domain that are solved by the finite element method and time-iterative integration. Several study cases of practical interest were analyzed, and the numerical results were presented. (See also W80-06858) (Sims-ISWS)
W80-06883

MODELLING OF LANDFILL LEACHATE MIGRATION,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W80-06884

SIMULATION OF SHARP FRONTS IN TWO DIMENSIONS WITH FINITE ELEMENT TECHNIQUES,
Washington Univ., Seattle. Dept. of Chemical Engineering.
O. K. Jensen, and B. A. Finlayson.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol.), Mississippi University, Oxford, May 19-23, 1980. p 5.169-5.180, 1980. 7 Fig, 2 Tab, 6 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Finite element analysis, *Porous media, *Model studies, *Flow, Analytical techniques, Simulation analysis, Analysis, Mathematical models, Convection, Diffusion, Pumping, Oil recovery processes.

A new solution technique was developed and tested on a representative model of enhanced oil recovery processes, that has similar numerical difficulties to those of the full model. For application to aoil field analyses, the differential equations are solved in two spatial dimensions and time. A program was developed with the necessary algorithms for the new technique. The improved calculation procedure enables one to describe sharp changes in the concentration as very high concentration gradients must be represented. For steady-state problems, such a representation requires a fine mesh near the steep gradient. The new solution technique can solve the model accurately for physically realistic parameters and the method shows potential cost savings by a factor of 10 compared to more conventional methods. (See also W80-06894) (Humphreys-ISWS)
W80-06917

ELASTIC GRID DEFORMATION FOR MOVING BOUNDARY PROBLEMS IN TWO SPACE DIMENSIONS,
Thayer School of Engineering, Hanover, NH.
D. R. Lynch, and K. O'Neill.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 7.111-7.120, 1980. 5 Fig, 8 Ref. Science and Education Administration, New Orleans, LA. NSF ENG-7908076.

Descriptors: *Finite element analysis, *Mathematical models, *Boundary processes, *Flow, Elastic deformation, Free surfaces, Analytical techniques, Freezing, Convection, Diffusion, Mathematical studies, Movement, Heat flow, Saturated soils, Boundaries(Surfaces), Moving boundary, Grids, Stefan problem.

This paper contributed to the development of basic simulation techniques needed to deal effectively with deforming finite element meshes. The authors focused on the one-phase Stefan problem in two space dimensions, which is a reasonable first approximation for the freezing process in coarse, saturated soils with negligible moisture movement. Two-dimensional simulation of the one-phase Stefan problem was demonstrated, using a generalized elasticity formulation for the determination of grid deformation. Large deformations and deformation rates were achieved without generating instability or unreasonable solutions. The method appears to be applicable to other types of moving boundary simulations in which the character of the solution cannot be conveniently specified beforehand. (See also W80-06894) (Humphreys-ISWS)
W80-06934

2G. Water In Soils

EFFECT OF EXCHANGEABLE SODIUM PERCENTAGE, CATION EXCHANGE CAPACITY, AND SOIL SOLUTION CONCENTRATION ON SOIL ELECTRICAL CONDUCTIVITY,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
For primary bibliographic entry see Field 2K.
W80-06487

SOME ACCURATE NUMERICAL SOLUTIONS OF THE SOIL-WATER DIFFUSION EQUATION,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
R. D. Braddock, and J-Y. Parlange.
Soil Science Society of America Journal, Vol 44, No 3, p 656-658, May-June 1980. 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Diffusion, *Infiltration, *Soil water movement, *Mathematical models, Analytical techniques, Analysis, Mathematical studies, Equations, Numerical analysis, Soil water, Percolation, Runge-Kutta techniques, Horizontal diffusion.

Some accurate numerical solutions were obtained for the soil-water diffusion equation. The method replaces the two end-point boundary value problem with a standard initial value problem and uses iteration to select the appropriate initial slope. The results obtained were accurate to seven significant figures, and the solution exhibited a wetting front with a sharp corner and foot at the leading edge of the front. The corner and foot highlighted ones ignorance of the processes by which water percolates the soil at low concentrations. (Humphreys-ISWS)
W80-06491

ON THE FORCE-RESTORE METHOD FOR PREDICTION OF GROUND SURFACE TEMPERATURE,
Connecticut Univ., Storrs. Dept. of Civil Engineering.
J. D. Lin.
Journal of Geophysical Research, Vol 85, No C6, p 3251-3254, June 20, 1980. 3 Fig, 12 Ref. NASA NSG-5346.

Descriptors: *Soil temperature, *Mathematical models, *Cycles, *Forecasting, Soil physical properties, Conductivity, Thermal capacity, Heat thermal radiation, Heat balance, Soil moisture, Temperature, Heat transfer, Thermal properties, Heat flow, Photoperiodism, On-site investigations, Measurement, Mathematical studies, Rain, Statistical models, Variability, Correlation analysis, Fluctuations, Arizona, Georgia.

The efficiency and accuracy of the prediction of the diurnal variation of ground surface tempera-

ture by the force-restore method was tested against two sets of field-measured data from Arizona and Georgia. The rate equation for the ground surface temperature (Tg) was rederived as one-half the sum of T as a function of time plus T as a function of sigma (depth) and time. The effect of the sigma layer thickness was investigated by a numerical experiment and a small but finite sigma value was found to underpredict the diurnal amplitude of the ground surface temperature. Alpha (which is the sum of one plus sigma divided by the damping depth of the diurnal temperature wave) was also found to be incapable of adjustment by changing the value of heat capacity. The ground surface temperature was measured at a soil depth of 1 cm in Arizona and 0.5 cm in Georgia and the results were in good agreement with the mathematical simulations. The method has a systematic tendency to overpredict or underpredict the ground surface temperature at night, but responds satisfactorily to rain events. (Sidney-IPA)
W80-06551

SELF-DIFFUSION AND VISCOSITY OF WATER IN CLAYS,
Science and Education Administration, Albany, CA. Western Regional Research Center.
D. Stigter.
Soil Science, Vol 130, No 1, p 1-6, July 1980. 4 Fig, 13 Ref.

Descriptors: *Soil water movement, *Clays, *Viscosity, *Mathematical models, Diffusion, Model studies, Analytical techniques, Theoretical analysis, Flow, Earth-water interfaces, Stokes law, Flow around objects.

The hydrodynamics of a sphere moving through a viscous liquid inside a slit was discussed. The effects of the walls were approximated by an image method. The correction of the diffusion coefficient of the sphere depends on the ratio of the slit width and the radius of the sphere. The theory was applied to the self-diffusion of water in swollen clays. Using the Stokes radius of a water molecule, the wall effects partially explain the reported decrease of self-diffusion in thin interlamellar water layers. The residual decrease corresponds to the immobilization of a small amount of water, of the order of half a monolayer at the clay-water interface. This is about equal to the commonly assumed hydration of the exchangeable cations. This interpretation of available data implies that there is no significant increase in the viscosity of the remaining interlamellar water and that there is no significant viscoelectric effect near charged clay surfaces. (Humphreys-ISWS)
W80-06613

PORE VOLUME DISTRIBUTION AND CURVE OF WATER CONTENT VERSUS SUCTION OF POROUS BODY: 3. THE EFFECT OF PORE STRUCTURE,
Tokyo University (Japan). Lab. of Soil Hydrology.
M. Nakano.
Soil Science, Vol 130, No 1, p 7-10, July 1980. 4 Fig, 9 Ref.

Descriptors: *Porous media, *Mathematical models, *Moisture content, *Drying, Pore water, Analytical techniques, Analysis, Model studies, Pores, Theoretical analysis, Interstices, Pore pressure, Aquifers, Foreign research, Suction.

This paper presented equations of drying curves proposed for a higher range of a factor that relates to pore structure and that predicts the effects of pore structure of porous bodies on the relationships between water content and suction. Equations representing the relationship between water content and suction were derived theoretically on porous bodies having developed structure, using a previously published model. The resulting equations showed the curves on which the minimum fraction of the total apparent water volume, which is retained in dimensionless suction range H to H + Delta H or log H to log H + Delta log H, appeared at a certain suction by the effect of the pore structure factor. (See also W76-12984 and W77-00162) (Humphreys-ISWS)
W80-06614

THE PHYSICAL PROPERTIES OF SOME ERODED SOILS OF SOUTHEASTERN NIGERIA,
Nigeria Univ., Nsukka. Dept. of Soil Science.
For primary bibliographic entry see Field 2J.
W80-06615

FINITE ELEMENT ANALYSIS OF EFFLUENT FLOW FROM SUBSURFACE SEWAGE DISPOSAL FIELDS,
Minnesota Univ., St. Paul.
For primary bibliographic entry see Field 5D.
W80-06623

A PREDICTOR-CORRECTOR ALTERNATING-DIRECTION IMPLICIT METHOD FOR TWO-DIMENSIONAL UNSTEADY SATURATED-UNSATURATED FLOW IN POROUS MEDIA,
Munich Univ. (Germany, F. R.). Inst. fuer Numerische and Instrumentelle Mathematik.
For primary bibliographic entry see Field 2F.
W80-06630

COMPARISON OF CALCULATED AND IN SITU MEASURED UNSATURATED HYDRAULIC CONDUCTIVITY,
Central Soil Salinity Research Inst., Karnal (India).
B. K. Khosla.
Journal of Hydrology, Vol 47, No 3/4, p 325-332, July 1980. 6 Fig, 2 Tab, 13 Ref.

Descriptors: *Hydraulic conductivity, *On-site investigations, *Model studies, Mathematical models, Groundwater, Groundwater movement, Unsaturated flow, Soil water, Soil water movement, Measurement, Theoretical analysis, Equations, Irrigation, Drainage, Soil properties, Soil science.

Unsaturated hydraulic conductivity of an alluvial sandy loam soil, classified as Haplustalf, was determined in situ by following internal drainage in an initially wetted profile over a period of 79 days. Soil moisture content of various layers was determined on several days within this period, and soil suction was recorded at various depths to obtain hydraulic gradients. The hydraulic conductivity at different depths was obtained using Darcy's equation, and experimentally determined values of hydraulic conductivity for the entire depth of 120 cm were represented by a single empirical relationship: $K = 5.13 \times 10$ to the minus 10th power exp(58.27 theta) cm/day. The profile features within this depth did not exhibit any distinct textural or structural variations. The calculated hydraulic conductivity using Campbell's equation, which requires only knowledge of the soil moisture characteristic and saturated hydraulic conductivity, agreed closely to the field-measured values. (Sims-ISWS)
W80-06631

EVALUATING HYDRODYNAMIC DISPERSION COEFFICIENTS,
Central Soil Salinity Research Inst., Karnal (India).
For primary bibliographic entry see Field 2F.
W80-06634

PARTICULAR SOLUTIONS TO THE PROBLEM OF HORIZONTAL FLOW OF WATER AND AIR THROUGH POROUS MEDIA NEAR A WETTING FRONT,
Cold Regions Research and Engineering Lab., Hanover, NH.
Y. Nakano.
Advances in Water Resources, Vol 3, No 2, p 81-84, June 1980. 9 Ref.

Descriptors: *Unsaturated flow, *Air-water interfaces, *Mathematical models, *Flow, Porous media, Wetting, Darcys law, Theoretical analysis, Equations, *Two-Phase flow, *Singularities, Wetting fronts, Air flow.

Particular solutions to the problem of horizontal flow of water and air through homogeneous porous media were derived, and regularity properties of the solutions were presented. It was found that a singularity occurs in the solutions at the wetting fronts. Effects of air flow on water flow were discussed. (Visocky-ISWS)
W80-06682

SIMULATION OF SOIL WATER AND SALT REGIMES DURING TRICKLE IRRIGATION,
Arizona Univ., Tucson.
For primary bibliographic entry see Field 3F.
W80-06688

VOLUMES OF SEA WATER FILTERED THROUGH EASTERN CAPE SANDY BEACHES,
Port Elizabeth Univ. (South Africa). Dept. of Zoology.
A. McLachlan.
South African Journal of Science (Johannesburg), Vol 75, No 2, p 75-79, 1979. 3 Fig, 1 Tab, 18 Ref.

Descriptors: *Sea water, *Volume, *Filtration, *Beaches, *Microorganisms, Digestion, Water purification, Water pollution, Sands, Dunes, Filters, Particle size, Percolation, Infiltration, Saturation, Mode of action, Percolating water, Porosity, Voids, Organic compounds, Ocean waves, Marine biology, Tides, Drainage, Path of pollutants, Biodegradation, Winds, Evaluation, Cycling nutrients, Mathematical studies, *South Africa.

Approximate figures for the volumes of sea water percolating through three sandy South African beaches were obtained to aid in the study of the nutrient cycling of these beaches. The meio- and microfauna in the sand break down huge quantities of dissolved and particulate matter deposited by wave action onto the beaches. The sea water volumes which flush into the sand by each wave are mediated by the tidal cycle, the texture of the sand, the direction of winds and swells, the sheltering of the beach, and the slope of the beach. The pore space volume is estimated by a wedge representing the total volume of sand that can receive water (saturation gap). The volume of water filtered through the sand is given by linear interpolation of swash lengths and frequencies. The average filtration volume of the Maitland River and Blue Water Bay readings resulted in an approximation of 10 cubic meters of shore per day for eastern Cape beaches. The average drainage speed is about 0.3 to 0.4 milliliter per second so that water would spend about 22 hours in the sand, which is sufficient time for the particulate organic matter to be digested. The volumes of percolated sea water recorded were between 3.8 to 15.2 cubic meters per day which is about double the values for American beaches which experience less tidal activity. (Sidney-IPA)
W80-06722

SPATIAL VARIABILITY OF RANGELAND INFILTRATION RATES,
Utah State Univ., Logan. Watershed Science Unit.
E. P. Springer, and G. F. Gifford.
Water Resources Bulletin, Vol 16, No 3, p 550-552, June 1980. 2 Tab, 7 Ref.

Descriptors: *Infiltration rates, *Spatial distribution, *Land use, *Ranges, *Idaho, Correlation analysis, Statistical methods, Infiltration, Runoff, Vegetation effects, Precipitation excess, Normal distribution, Log normal distribution.

Spatial variability of infiltration rates was examined for a site in southern Idaho. Data used represented 13 sampling dates over a 5-year period. Samples initially were taken within a native big sagebrush community, again after plowing and seeding to crested and intermediate wheatgrass, and then while the seeded area was being grazed by domestic livestock. Results indicate that either a normal or log normal distribution may be adequate for describing measured infiltration rates. (Visocky-ISWS)
W80-06754

FIELD DETERMINATIONS OF SOIL HYDRAULIC PROPERTIES FOR STATISTICAL ANALYSES,
Agricultural Research Organization, Bet Dagan (Israel). Div. of Soil Physics.
D. Russo, and E. Bresler.

Soil Science Society of America Journal, Vol 44, No 4, p 697-702, July-August 1980. 6 Fig, 3 Tab, 34 Ref.

Descriptors: *Soil properties, *Hydraulic properties, *Statistical methods, Monte Carlo method, Spatial distribution, Variability, Hydraulic conductivity, Statistical models, Drainage, Unsteady flow, Soil water, Retention, Permeameters, Moisture content, Pressure head.

A procedure for repetitive determinations of soil hydraulic properties was based on the assumption that the functional relationships between soil water content (theta) and soil water pressure head (h), and between the hydraulic conductivity (K) and h, can be expressed mathematically. The parameters in the mathematical expression are: saturated hydraulic conductivity (K sub s) and water content (theta sub s), residual (or irreducible) water content (theta sub r), water entry value of h (h sub w), and the parameters eta and beta, characterizing the pore size distribution of the soil. Values of K sub s and h sub w are measured by the air-entry permeameter of H. Bouwer. The parameters eta and beta were calculated with measured values of K sub s, h sub w, theta sub s, theta sub r, and the sorptivity, S, as measured by C. Dirksen's method. The variability in the determination of the K(theta) function was evaluated in the field, from 30 measurements of each of the 6 parameters made in a single 2-by-2 m site. This variability is smaller than the variability of K(theta) as calculated from a simulation of a transient drainage. The K(h) and theta(h) functions are rapidly obtained and thus suitable for performing large numbers of measurements for the determination of the probability density functions (and joint probability density functions) of the soil hydraulic conductivity, K(theta), and soil water retentivity, h(theta), functions. (Viscocky-ISWS)
W80-06763

EXPERIMENTAL AND MATHEMATICAL DESCRIPTION OF NONADSORBED SOLUTE TRANSFER BY DIFFUSION IN SPHERICAL AGGREGATES,
Florida Univ., Gainesville. Dept. of Soil Science.
P. S. C. Rao, R. E. Jessup, D. E. Rolston, J. M. Davidson, and D. P. Kilcrease.
Soil Science Society of America Journal, Vol 44, No 4, p 684-688, July-August 1980. 2 Fig, 2 Tab, 16 Ref, 1 Append.

Descriptors: *Soil water, *Soil science, *Model studies, *Laboratory tests, Theoretical analysis, Diffusion, Chlorine, Mathematical models, Analytical techniques, Analysis, Calibrations, Soil water movement, Tracers, Porous media, Model verification, Tritiated water, Aggregated soils, Solute transport.

Diffusion of nonadsorbed solutes (3H20 and 36C1(-)) out of two sizes of porous ceramic spheres (0.55- and 0.75-cm radius) was measured. These data were analysed to provide independent estimates of the input parameters required in two simulation models for describing solute transport in aggregated porous media with distinct mobile and stagnant pore-water regions. Tracer-saturated porous spheres were placed in tracer-free 0.01N CaC12 solution, and the rate of tracer diffusion out of the porous spheres was measured by monitoring the increase in tracer concentration with time in the external electrolyte solution. Experimental results were analyzed using two mathematical models. Fick's second law, written in spherical coordinates, formed the basis for Model I. In Model II, the time-rate of solute transfer into or out of the porous spheres was assumed to be proportional to the difference in tracer concentration inside and outside the porous spheres. The analytical solution to Model I for given initial and boundary conditions was substituted into Model II, to derive an explicit expression relating the empirical mass transfer rate coefficient (alpha) in Model II and known physical constants of the system. This theoretical analysis indicated that the alpha value is dependent upon the sphere radius, time of diffusion, volumetric water contents inside and outside the sphere, and the molcular diffusion coefficient. Over a range of experimental conditions, excellent agreement was found between measured alpha values and those calculated using the analytic expression developed. (Humphreys-ISWS)
W80-06764

SCALING SOIL HYDRAULIC PROPERTIES OF A HETEROGENEOUS FIELD,
Agricultural Research Organization, Bet Dagan (Israel). Div. of Soil Physics.
D. Russo, and E. Bresler.
Soil Science Society of America Journal, Vol 44, No 4, p 681-684, July-August 1980. 2 Fig, 12 Ref.

Descriptors: *Soil moisture, *Moisture content, *Soil properties, *Hydraulic conductivity, *Statistical models, On-site data collections, Pressure head, Saturation, Saturated soils, Permeability, Regression analysis, Spatial distribution, Variability, Heterogeneity, Unsaturated flow, Unsaturated hydraulic conductivity.

Field data for soil water characteristics and hydraulic conductivity have been scaled by two methods. The set of scaling factors (alpha sub j) determined by one method depends on soil water content. A correlation of sq r = 0.86 is obtained between scaling factors determined from soil characteristic data and those determined from hydraulic conductivity data. In the second method, the set of alpha sub j is normally distributed, and is highly correlated with alpha sub j obtained by the first method from water characteristic data at water contents near saturation. In one method the sum of squares, about an average curve, was reduced by 44 and 66%, for the water characteristics and hydraulic conductivities data, respectively, while 92 and 82.5% reduction was obtained by the second method, for the same respective data. The results suggest that in practice a single stochastic variable may represent the hydraulic properties of a heterogeneous field. (Visocky-ISWS)
W80-06765

STOCHASTIC MODEL OF WATER TABLE UNDER DRAINAGE,
Dames and Moore, Los Angeles, CA. Advanced Technology Group.
For primary bibliographic entry see Field 2F.
W80-06826

THE SWELLING OF CLAY: II. MONTMORILLONITES,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
P. F. Low.
Soil Science Society of America Journal, Vol 44, No 4, p 667-676, July-August 1980. 9 Fig, 8 Tab, 24 Ref.

Descriptors: *Clays, *Expansive clays, *Montmorillonite, Laboratory tests, *Moisture content, Physical properties, Data collections, Clay minerals, Analysis, Analytical techniques, Soil pressure, Measurement, Cation exchange, Methodology, Testing procedures, Mathematical models.

The water content at equilibrium was determined as a function of applied pressure for 35 different Na-saturated montmorillonites by means of a miniature pressure membrane apparatus. Then the data were used to develop a general, empirical equation in which the swelling pressure of the montmorillonite depends exponentially on the water content. The parameters in this equation were shown to be functions of the cation exchange capacity and specific surface area of the montmorillonite. The data were also used to develop semiempirical equations in which the swelling pressure depends exponentially on the distance between the superimposed layers of the montmorillonite. Depending on the assumptions used in their development, the latter equations involve constant coefficients or coefficients that depend on the surface charge density of the montmorillonite. Analysis of these equations indicated that swelling is due primarily to interaction between the layer surfaces and water. (Humphreys-ISWS)
W80-06835

HEXACHLOROBENZENE: ITS VAPOR PRESSURE AND VAPOR PHASE DIFFUSION IN SOIL,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 5B.
W80-06836

A COMPARISON OF DIFFERENT METHODS FOR MEASURING SOIL SALINITY,
Agricultural Research Organization, Bet Dagan (Israel). Div. of Soil Physics.
For primary bibliographic entry see Field 5A.
W80-06837

FACTORS INFLUENCING OXYGEN CONSUMPTION RATES IN FLOODED SOILS,
Agricultural Research and Education Center, Sanford, FL. Inst. of Food and Agricultural Sciences.
K. R. Reddy, P. S. C. Rao, and W. H. Patrick, Jr.
Soil Science Society of America Journal, Vol 44, No 4, p 741-744, July-August 1980. 2 Fig, 1 Tab, 15 Ref.

Descriptors: *Saturated soils, *Soil chemistry, *Oxygen requirements, *Physicochemical properties, Anaerobic conditions, Soils, Kinetics, Soil science, Chemical reactions, Reduction(Chemical), Iron, Manganese, Laboratory tests, Testing procedures, Methodology, Analytical techniques, Flooded soils.

Thirty-seven surface soil samples varying in physicochemical properties were incubated under reduced (anaerobic) conditions to study the factors influencing oxygen consumption rates. Oxygen consumption rates were measured after introduction of a known amount of oxygen into a reduced (anaerobic) soil system and following the disappearance of oxygen as a function of time. The time dependence of oxygen consumption in all flooded soils could be described as a two-phase first order reaction process. Rapid oxygen consumption during Phase I was followed by relatively slower consumption during Phase II. The first-order rate coefficient (k sub I, per hour) for Phase I was approximtely the same for all 37 soils evaluated, whereas each soil was characterized by a different rate coefficient (k sub II, per hour) for Phase II. The average value for k sub I was 0.15/hour (coefficient of variation = 20%) while the values of k sub II ranged from 0.0027 to 0.054/hour. Stepwise regression analysis of the data showed that NaOAc-extractable Fe of a reduced soil was the single best predictor of k sub II and also the fractional consumption associated with Phase I. Significant improvement in these regressions was obtained when total NH4-N content of the reduced soil, in addition to reducible Fe(2+) was considered. (Humphreys-ISWS)
W80-06838

USE OF SOIL SURVEY DATA IN A MODEL FOR SIMULATING REGIONAL SOIL MOISTURE REGIMES,
Soil Survey Inst., Wageningen (Netherlands).
J. Bouma, P. J. M. de Laat, R. H. C. M. Awater, H. C. van Heesen, and A. F. van Holst.
Soil Science Society of America Journal, Vol 44, No 4, p 808-814, July-August 1980. 5 Fig, 4 Tab, 11 Ref.

Descriptors: *Computer models, *Soil types, *Soil moisture, *Water table, Evapotranspiration, Root zone, Mapping, Measurement, Soil horizons, Soil texture, Bulk density, Organic matter, Hydraulic conductivity, Retention, Depth, Soil survey data, GELGAM.

Depth to water table and evapotranspiration rates were simulated with the computer program GELGAM for an area of 6 by 6 km, which was described by square nodal areas of 25 ha each in a grid with a mesh width of 500 m. Simulation runs were made in four phases as follows: (1) identical estimates for all nodal areas; (2) estimates based on an existing soil map; (3) estimates from one on-site boring per nodal area, and (4) measurements of physical data. Simulated depth to water table agreed well with measured depths in all phases, but

only when using measured physical data for the deeper subsoil. Simulated evapotranspiration using phase 1 data produced poor results for individual nodal areas when compared with phase 4 data (reference level), while phase 2 data produced good results if measured physical data for the deeper subsoil were included. Physical variability of nodal areas was better characterized by the soil survey data than by results from a single boring (phase 3). Use of existing soil survey data, in combination with selected on-site investigations, could reduce the cost of data gathering in this study by an estimated 50% as compared with the common procedure of making systematic borings in each grid point. (Visocky-ISWS)
W80-06839

CHANGES IN PROPERTIES OF A NEWLY CLEARED TROPICAL ALFISOL AS AFFECTED BY MULCHING,
International Inst. of Tropical Agriculture, Ibadan (Nigeria).
R. Lal, D. De Vleeschauwer, and R. M. Nganje.
Soil Science Society of America Journal, Vol 44, No 4, p 827-833, July-August 1980. 2 Fig, 10 Tab, 29 Ref.

Descriptors: *Mulching, *Effects, *Soil properties, *On-site investigations, *Africa, Infiltration, Tropical regions, Porosity, Soil temperature, *Soil moisture, Soil water, Hydraulic conductivity, Particle size, Soil physics, Soil physical properties, Soil structure, Bulk density, Chemicals, Soil chemistry, Runoff, Soil erosion, Agriculture.

Rapid deterioration in soil physical properties following deforestation for arable land use adversely affects crop production from soils in the humid and subhumid tropics. This investigation was conducted to determine whether the rate of deterioration can be minimized by the use of crop residue mulches. Changes in soil properties of a newly cleared tropical Alfisol resulting from mulch rates of 0, 2, 4, 6, and 12 tons/ha/season of rice (Oryza sativa) straw were investigated from 1976 to 1977. Total porosity, 18 months after initiating the experiment, was 48, 50, 55, 55, and 59%, respectively, for increasing mulch rate. Similarly affected were relative proportions of macropores, saturated hydraulic conductivities, field infiltration rates, and moisture retention at 0.1 and 0.3 bar suctions. Decrease in the maximum temperature was 3.3, 4.1, 4.5, and 5.4 C for 2, 4, 6, and 12 ton/ha mulch rates, respectively, compared with the unmulched control. The water runoff was 18, 10, 4, 1, and 0% of the rainfall received for increasing mulch rates, respectively. The chemical fertility of the soil decreased with time after forest removal. However, the rate of degradation was less with increasing mulch rate. The rate of decline of organic matter content over the 18-month period was 0.103, 0.100, 0.092, 0.083, and 0.078% per month for 0, 2, 4, 6, and 12 tons/ha of mulch, respectively. (Sims-ISWS)
W80-06841

A RAPID IN SITU METHOD OF EXTRACTING WATER FROM TIDAL MARSH SOILS,
Gulf Coast Research Lab., Ocean Springs, MS. Botany Section.
L. N. Eleuterius.
Soil Science Society of America Journal, Vol 44, No 4, p 884-886, July-August 1980. 1 Fig, 10 Ref.

Descriptors: *Soil water, *Sampling, *Equipment, *Tidal marshes, On-site data collections, On-site investigations, Coasts, Marshes, Salinity, Estuarine environment, Pressure, Siphons, Soils, Estuaries.

An inexpensive, easily constructed apparatus was developed to extract interstitial soil water from the soils of tidal marshes. Major components of the apparatus are a polypropylene bottle, polyethylene tubing, neoprene stopper, and plankton netting. The sampler can be easily placed at varying depths in the soil and left permanently in the field. The system can also be used for fertilizer and dye injection studies. Because of its simplicity, durability, and versatility this vacuum-pressure lysimeter is well suited for use in the marsh. (Sims-ISWS)
W80-06842

THE B.I.E.M. APPLIED TO FLOW THROUGH POROUS MEDIA,
Escuela Tecnica Superior de Ingenieros Industriales, Madrid (Spain).
S. Gomez, J. A. Corona, and E. Alarcon.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 2.3-2.14, 1980. 5 Fig, 4 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Soil water movement, *Porous media, *Model studies, *Mathematical models, Equations, Analytical techniques, Boundary processes, Infiltration, Dams, Soil water, Groundwater.

This paper referred to the numerical solution of the classical Darcy's problem of plane fluid through isotropic media. As it is well known that if h = Z + F/gamma is the piezometric height at a point of the medium under study, the h potential is a harmonic one, and the mean flow can be assimilated to an irrotational perfect fluid one. (See also W80-06858) (Sims-ISWS)
W80-06863

PERSPECTIVE ON A MODIFIED CONJUGATE GRADIENT METHOD FOR THE FINITE ELEMENT SOLUTION OF LINEAR SUBSURFACE EQUATIONS,
IBM Italy Scientific Center, Rome.
For primary bibliographic entry see Field 2F.
W80-06864

FINITE ELEMENT MODELS FOR UNSATURATED GROUNDWATER ZONES,
Resource Management Associates, Lafayette, CA.
For primary bibliographic entry see Field 2F.
W80-06865

FREE SURFACE SEEPAGE IN EARTH BANKS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
C. S. Desai, and T. K. Kuppusamy.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol.), Mississippi University, Oxford, May 19-23, 1980. p 2.45-2.47, 1980. Science and Education Administration, New Orleans, LA.

Descriptors: *Seepage, *Dams, *Banks, *Model studies, Mathematical models, Soil water, Soil water movement, Flow, Soil properties, Numerical analysis, Finite element analysis, Theoretical analysis, Simulation analysis, Equations.

The main purpose of this paper was to describe development and application of finite element procedures for analysis of free surface seepage in earth banks and dams. A description of the available finite element procedures for free surface flow was presented together with details of a new procedure based on the 'residual flow' method. Potential of applications of the procedures developed was given particular attention. A number of field situations, such as behavior of seepage in homogeneous and zoned dams and the influence of applications of a repeated hydrograph due to fluctuations in a river on the water table in the surrounding areas, were considered. In addition, application and verifications with respect to results from a laboratory model, such as a glass-bead model, were also presented. (See also W80-06858) (Sims-ISWS)
W80-06866

SEEPAGE FLOW IN EXTREMELY THIN AQUIFERS,
Bochum Univ. (Germany, F.R.). Inst. fuer Konstrucktiven Ingenieurban.
G. Schmid.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol.), Mississippi University, Oxford, May 19-23, 1980. p 2.48-2.55, 1980. 3 Fig, 2 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Seepage, *Nitrates, *Groundwater movement, *Model studies, Mathematical models, Finite element analysis, Analytical techniques, Groundwater, Pollutants, Path of pollutants, Water pollution, Aquifers, Thin aquifers.

The waterworks Mussum in North Rhine-Westfalia in West Germany had to be closed down temporarily in March 1979 due to too high a concentration of nitrate (130 ppm N03) in the water. The horizontal extension of the catchment area is approximately 2 km. It is covered with grassland with a variable intensity of fertilization. The waterworks were interested in locating the source of the nitrate, therefore, the flow path of nitrate through the aquifer into the well had to be found. Seepage flow can be formulated bythe potential or stream function approach. If the velocity field and the flow path are of primary interest, the stream function approach is of advantage. Even for aquifers with an extremely thin vertical groundwater thickness, the stream function approach can still produce the desired flow field, whereas the potential approach simulates only a one-dimensional flow where the important vertical components, which determine the penetration into the aquifer, are lost. (See also W80-06858) (Sims-ISWS)
W80-06867

NON-LINEAR GROUNDWATER FLOW SIMULATION,
Soil Mechanics Lab., Delft (The Netherlands).
For primary bibliographic entry see Field 2F.
W80-06868

ADJOINT-STATE FINITE ELEMENT EQUATIONS FOR PARAMETER ESTIMATION,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 2F.
W80-06869

AN EXPANDED SOLUTE TRANSPORT MODEL FOR SIMULATING GROUNDWATER CONTAMINATION EPISODES,
Notre Dame Univ., IN. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W80-06875

FREE SURFACE AND SATURATED-UNSATURATED ANALYSES OF BOREHOLE INFILTRATION TESTS ABOVE THE WATER TABLE,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
D. B. Stephens, and S. P. Neuman.

Descriptors: *Hydraulic conductivity, *Infiltration, *Boreholes, *Model studies, Mathematical models, Finite element analysis, Soil water, Soil water movement, Saturated flow, Vadose water, Seepage, Dams, Numerical analysis, Simulation analysis, Analytical techniques.

One of the most important parameters required to model infiltration or contaminant transport through the vadose zone is hydraulic conductivity. As a specific example, methods to predict seepage beneath a proposed dam site where the water table lies deep below the land surface call for a measurement of hydraulic conductivity at saturation, K sub s. In order to compute the actual hydraulic conductivity at any given water content below saturation, numerous empirical and statistical methods have been developed. However, these methods usually require knowledge of K sub s. At present, the only known method of determining K sub s in situ at depths greater than a few meters is the so-called borehole infiltration test. The method requires constructing a cased or uncased borehole of known diameter, filling it with water, and measuring either the rate at which the water level declines with time (falling head test) or the rate at which water must be added to maintain a constant water level or injection pressure in the borehole (constant head test). Only constant head borehole infiltration tests were considered in this paper. The accuracy of the Glover and Nasberg-Terletskata formulas under the assumption that the free surface concept is a valid representation of the real flow system was examined. This was done by compar-

ing these formulas with results obtained from a finite element model of free surface flow that does not suffer from the limitations of the analytical approach. In order to investigate the extent to which the very concept of free surface flow is valid, the same problem of infiltration from a borehole was also analyzed with the aid of two numerical models that view the infiltration process in a more realistic light: Instead of assuming that the soil outside the free surface envelope is dry, these models allow the soil to be partially saturated, as is the case in nature. (See also W80-06858) (Sims-ISWS)
W80-06882

FINITE ELEMENT METHOD IN SOLVING SOME UNUSUAL PROBLEMS OF INFILTRATION IN POROUS MEDIA,
Polytechnical Inst. of Bucharest (Rumania). Dept. of Hydraulics.
For primary bibliographic entry see Field 2F.
W80-06883

EVALUATION OF COEFFICIENT MATRICES OF LINEAR TRIANGULAR ELEMENTS INVOLVING UNSATURATED SOIL MOISTURE FLOW,
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
J. L. Nieber.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 2.260-2.269, 1980. 4 Fig, 6 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Soil water movement, *Porous media, *Model studies, Mathematical models, Finite element analysis, Numerical analysis, Simulation analysis, Evaluation, Hydraulic conductivity, Pressure head, Capillary conductivity, Flow, Soil water, Computer programs.

The Richards equation was used to describe the flow of a liquid in a porous medium. The procedure to solve the two-dimensional form of this equation by the finite element method was outlined briefly. Two approaches for evaluating the resulting coefficient matrices were investigated in detail In the first approach the capacitance and conductivity coefficients were assumed to vary linearly over each element. Since this assumption was violated in most cases the integration of the coefficient matrices will result in volume errors. The second approach allowed the coefficients to vary in a nonlinear fashion over each element. The evaluation of the coefficient matrices was performed with Gauss quadrature integration. This evaluation procedure reduces volume errors to a negligible level. Comparison of simulated results using the two approaches demonstrated that the volume errors have a significant effect on a numerical solution. The costs of simulation for comparable problems were found to be approximately 1.5 times greater for a computer program using the second integral evaluation approach than for a computer program using the first integral evaluation approach. (See also W80-06858) (Sims-ISWS)
W80-06885

A COMPARISON OF NUMERICAL SOLUTIONS OF THE ONE-DIMENSIONAL UNSATURATED-SATURATED FLOW AND MASS TRANSPORT EQUATIONS,
Science and Education Administration, Riverside, CA. Salinity Lab.
M. Th. van Genuchten.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol.), Mississippi University, Oxford, May 19-23, 1980. p 3.49-3.66, 1980. 8 Fig, 1 Tab, 20 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Flow, *Mass transfer, *Soil water movement, *Model studies, Mathematical models, Finite element analysis, Numerical analysis, Mathematics, Equations, Saturated flow, Soil water, Moisture content, Profiles, Analytical techniques, Unsaturated flow.

The simultaneous transport of water and solutes under transient unsaturated-saturated conditions plays an important role in many branches of agriculture and engineering. In agriculture, for example, many chemicals such as fertilizers, pesticides, as well as those naturally present in irrigation waters, are routinely applied to the field. Some of these chemicals will remain in the root zone or will be taken up by plant roots, while others are subject to leaching, thereby becoming potential groundwater pollutants. The frequent use of land for the disposal of a wide variety of domestic and industrial wastes further accentuates the importance of the unsaturated zone. A clear understanding of chemical transport in the unsaturated zone, including proper quantification of the relevant transport processes, is therefore important for both agricultural and environmental engineers. Extensive research in this area has led to a large number of papers dealing with unsaturated zone transport. Most of the earlier numerical studies have used finite difference techniques for solution of the governing equations, although recently several finite element solutions also have been published. It was the purpose of this paper to compare the accuracy and computational efficiency of several numerical schemes for solution of the governing one-dimensional flow and mass transport equations. (See also W80-06858) (Sims-ISWS)
W80-06889

A SIMPLE TECHNIQUE FOR THE ANALYSIS OF FREE SURFACE FLOW PROBLEMS,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Civil Engineering and Building Technology.
P. W. France.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 5.20-5.27, 1980. 4 Fig, 7 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Finite element analysis, *Mathematical models, *Air-water interfaces, *Porous media, Free surfaces, Seepage, Methodology, Flow, Analytical techniques, Analysis, Approximation method, Boundaries(Surfaces), Embankments.

In any numerical approach for the analysis of free surface flow problems the exact position of the surface is not known a priori, and its location forms part of the analysis. Using a numerical technique however, it is possible to specify either pressure or flow rates along a boundary but not both simultaneously. For example in steady state seepage problems two conditions must be satisfied on the free surface: (1) pressure = atmospheric, and (2) Vn = 0, where Vn is the normal velocity. The solution of this type of problem includes locating the position of the upper boundary that has both zero flow normal to it, and prescribed pressure. This can be achieved by assuming an arbitrary location, setting either condition (1) or (2) and successfully adjusting its position until both of these conditions are satisfied simultaneously. A simple technique for locating the free boundary was devised in which all the elements remain fixed in space but with the upper boundary passing through them. Since the computer costs depend directly on the number of geometry changes, considerable economy is achieved as it is only necessary to formulate the various matrices for the initial step. (See also W80-06894) (Humphreys-ISWS)
W80-06904

2H. Lakes

VERTICAL MIXING OF LAKE SEDIMENTS BY TUBIFICID OLIGOCHAETES,
California Univ., Santa Barbara. Dept. of Mechanical and Environmental Engineering.
J. B. Fisher, W. J. Lick, P. L. McCall, and J. A. Robbins.
Journal of Geophysical Research, Vol 85, No C7, p 3997-4006, July 20, 1980. 9 Fig, 3 Tab, 53 Ref.

Descriptors: *Lake sediments, *Lake Erie, *Mixing, *Oligochaetes, Tubificides, Lakes, Laboratory tests, Mathematical models, Methodology, Analytical techniques, Tracers, Cesium, Sediments, Velocity, Data collections.

Vertical mixing of lake sediments by tubificid oligochaetes was studied in laboratory experiments by using a radioactive (cesium 137 labeled sediment) marker horizon. Results from these experiments were used to develop and test a mathematical model describing tubificid sediment mixing as a dominantly advective process. Tubificids were found to mix sediments to a depth of 6-9 cm. The rate of tubificid sediment processing observed in the experiments agreed well with those reported by other workers. Extrapolation of laboratory results to Lake Erie shows that the feeding activity of tubificids alone may result in significant sediment mixing throughout the lake. (Humphreys-ISWS)
W80-06500

QUANTITATIVE INTERPRETATION OF GREAT LAKES REMOTE SENSING DATA,
National Aeronautics and Space Administration, Cleveland, OH. Lewis Research Center.
For primary bibliographic entry see Field 7B.
W80-06501

WATER QUALITY OF ROGERS LAKE, DAKOTA COUNTY, MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
M. R. Have.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-175441, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-5, January 1980. 35 p, 5 Fig, 8 Tab, 24 Ref.

Descriptors: *Water quality, *Lakes, *Limnology, *Minnesota, *Baseline studies, Environmental effects, Road construction, Urbanization, Chemical properties, Physical properties, Biological properties, Eutrophication, Algae, Chemical analysis, *Rogers Lake(MN), *Dakota County(MN).

Construction of an interstate highway is planned near Rogers Lake in Dakota County, MN. Samples of water and bed material were collected at six sites during March 1976 to April 1978 to determine selected physical, chemical, and biological characteristics before construction. Samples were collected at least twice during each season of the year. Data derived from these samples will provide baseline information to aid in assessing the impact of highway construction on the water quality of the lake. Rogers Lake is separated into an upper and lower lake by a culvert; both were eutrophic and dominated by blue-green algae year around. The upper lake is a closed basin; it is shallower and contains less water than the lower lake and had higher concentrations of dissolved solids, nitrogen, and phosphorus. Phytoplankton cell counts were also higher in the upper lake. Analyses of water from Rogers Lake suggest that sodium and chloride concentrations were higher than in ground water or in water in some surrounding lakes. Sodium ranged from 7.2 to 55 milligrams per liter, and chloride ranged from 15 to 130 milligrams per liter. Concentrations were highest in March 1978, when most of the lake water was frozen. Much of the sodium and chloride may have been derived from road salts used for deicing. (USGS)
W80-06524

MAINTENANCE OF IRON MEROMIXIS BY IRON REDEPOSITION IN A RAPIDLY FLUSHED MONIMOLIMNION,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater inst.
P. Campbell, and T. Torgersen.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 8, p 1303-1313, August 1980. 8 Fig, 4 Tab, 23 Ref.

Descriptors: *Lakes, *Water quality, *Water circulation, *Limnology, Meromixis, Data collections, Organic matter, Carbon, Inorganic compounds, Nutrients, On-site investigations, Analysis, Analytical techniques, Dissolved oxygen, Tritium,

Dating, Water, Tracers, Iron, Oxidation-reduction potential, Monimolimnion, Chemocline, Helium isotope, Water renewal, Lake flushing, Chemical budget.

Water mass ages determined by the 3He-3He method gave a water renewal time of 2.5 plus or minus 1 year for the monimolimnion of softwater iron meromictic Lake 120. The water renewal time of the monimolimnion is less than or equal to the renewal time of the whole lake. The monimolimnion of Lake 120 was not found to be a stratum of 'perennially stagnant deep water.' The rates of supply to, and degradation of, organic matter in the monimolimnion are responsible, in the first place, for the low redox potential necessary to establish the high concentrations of soluble Fe(2+) observed (up to 4.2 mmol/L). However, it was found that the major key to maintenance of high monimolimnetic concentrations of Fe, i.e., maintenance of iron meromixis, is recycling of Fe at the chemocline by an equilibrium between Fe(2+) and Fe(3+) + e(-) 'Ferrous Wheel.' Up to 90% recycling of iron between chemocline and monimolimnion results in an iron residence time of approximately 15 yr for the whole lake (greater than 4 times the whole lake water renewal time). (Humphreys-ISWS)
W80-06612

MAN-MADE CHANGES IN THE FRESHWATER INPUT RATES OF HUDSON AND JAMES BAYS,
Canada Centre for Inland Waters, Burlington (Ontario).
S. J. Prinsenberg.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 7, p 1101-1110, July 1980. 5 Fig, 7 Tab, 16 Ref.

Descriptors: *Input-output analysis, *Freshwater, *Bays, Evaporation, Precipitation(Atmospheric), Rivers, River flow, Runoff, Hydroelectric power, Watersheds(Basins), Discharge(Water), *James Bay, *Hudson Bay, *Runoff alteration, Man-made changes, Input rates, River runoff rates, Hydroelectric developments, Canada.

The freshwater input rates of the Hudson/James Bay region were obtained on a monthly time scale and included contributions of evaporation, precipitation, and river runoff. The yearly mean precipitation minus evaporation rates showed that it behaved as an oceanic region supplying the overlying air mass with moisture. The monthly runoff rates for the total region and James Bay alone had minimum values during the winter and maximum values during the spring freshet. The total freshwater input can be divided into a summer and winter season. The large input of the summer represented an average monthly addition of a 10.0-cm layer of freshwater, while the smaller winter input amounted to an addition of a 0.5-cm layer of freshwater. Annually, the total surface area received a layer of 64-cm of freshwater. (Roberts-ISWS)
W80-06684

ASSESSING THE IMPACT OF SEDIMENTARY PHOSPHORUS IN LAKE CAYUGA,
New York State Coll. of Agriculture and Life Science, Ithaca. Section of Ecology and Systematics.
M. S. Glase, and J. P. Barlow.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-104895, Price codes: A03 in paper copy, A01 in microfiche. Project Completion Report, September, 1980. 26 p, 12 Fig, 1 Tab, 13 Ref. OWRT-A-084-NY (1), 14-34-0001-8034, 14-34-0001-9034.

Descriptors: *Phosphorus, Phosphorus compounds, *Lake sediments, Rivers, *Sediment-water interfaces, River flow, Discharge(Water), New York, Analytical techniques, Lakes, Inflow, Environmental gradient, Methodology, Surveys, Sampling, Algae, Water quality, Runoff, Environmental effects, Tracers, *Lake Cayuga(NY).

Most phosphorus (P) carried by streams is associated with particulate matter (e.g., clays), with much P firmly bound and a variable amount of P more loosely bound. The release/takeup of P by particles before they settle is determined by zone conditions where river water (Salmon Creek) mixes into the lake (Cayuga). This study used a natural tracer (Na) to estimate P exchanges between suspended matter and water in the river water-lake mixing zone. The river peak discharge plume was sampled during six runoff episodes during 1975-1979. Laboratory analyses were made for soluble reactive P (SRP), total soluble P, soluble unreactive P (SUP), and total P (TP), using established methods, with Na determined by flame emission. The maximum Na gradient was found close to the river mouth. SRP was usually adsorbed and SUP was usually desorbed, with SRP adsorption usually exceeding SUP desorption (by a net uptake of roughly 0.4 gm at P/liter stream water added). This may be significant, since an average lake concentration of TP is about 0.7 micrograms/liter. Estimates of net soluble P takeup are speculative, and more intensive studies are required that would provide new information on aspects of P cycle of lakes.(Zielinski-IPA)
W80-06706

REVERSED VERTICAL MIGRATION OF PLANKTONIC CRUSTACEANS IN A EUTROPHIC LAKE OF HIGH PH,
National Inst. for Water Research, Congella (South Africa).
A. D. Connell.
Journal of the Limnological Society of Southern Africa (Bloemfontein), Vol 4, No 2, p 101-104, 1978. 6 Fig, 7 Ref.

Descriptors: *Vertical migration, *Zooplankton, *Diurnal distribution, Diel migration, *Migration patterns, Biorhythms, Temporal distribution, Dams, Lakes, Plankton, Eutrophication, Population, Depth, Seasonal, Temperature, Rotifers, Daphnia, Biomass, Standing crops, Sampling, Graphical analysis, South Africa, Hartbeespoort Dam(South Africa).

Two studies of the phenomenon of reversed vertical migration of zooplankton were carried out in the Hartbeespoort Dam, a hyper-eutrophic, monomictic manmade South African lake. The total number of animals was counted in each of the two studies by depth sampling techniques during the summer and winter and the data were presented as kite drawings. Sampling was conducted hourly and by use of the kite drawings, the vertical migration of the dominant species of zooplankton, Daphnia pulex, D. longispina, and Thermocyclops oblongatus, can be traced. The lake is anaerobic below 15 m depth during the summer months and homogeneous, aerobic conditions existed throughout the water columns during the winter months. The rotifer Asplanchan priodonta exhibited reverse vertical migration, but the factor responsible for the reversed migration is not known. Interspecific interference has been suggested as a cause for these types of unusual movements, but the phenomenon remains unproven by this study since the species concerned were by far the total biomass and size dominants of the zooplankton population. (Sidney-IPA)
W80-06715

PROPOSED CRITERIA FOR INTERPRETING STABILITY OF LAKESHORE BLUFFS,
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
T. B. Edil, and B. J. Haas.
Engineering Geology, Vol 16, No 1/2, p 97-110, July 1980. 10 Fig, 1 Tab, 7 Ref.

Descriptors: *Lake shores, *Landslides, *Lake Michigan, *Beach erosion, Slope stability, Lakes, Waves(Water), Solifluction, On-site investigations, Groundwater, Water levels, Soil mechanics, Failure(Mechanics), Slip-circle method, Slopes, Analytical techniques, Analysis, Coastal engineering, Moisture content, Glacial soils, Mass wasting, Coastal bluffs.

The stability of the bluffs along the Lake Michigan shoreline in eastern Wisconsin has been assessed. The geotechnical properties of the bluff materials which can be broadly grouped as glacial tills, lacustrine silts and clays, and sandy outwash have been determined and related to the failure phenomena seen in the bluffs. Two separate criteria were proposed to help interpret the state of stability of these extremely active bluffs. The 'critical circle' criterion defines the failure in terms of the circle having the smallest safety factor and decribes the process of lakeshore bluffs as being a succession of small rotational slides which retrogress from the toe to the top of the bluff. The 'unstable circle' criterion, on the other hand, assumes the failure to occur throughout the zone enveloped by the largest circle indicating a safety factor less than unity and may be thought of as a culmination of critical circles that fail approximately at the same time. These criteria allow the recognition of slope evolutionary phenomena likely to take place in the bluffs. The effect of various parameters on these two criteria has also been investigated by examining specific profiles encountered along the Lake Michigan shoreline. Some examples of general coastal bluff conditions in the eastern Wisconsin counties were presented. (Humphreys-ISWS)
W80-06761

MECHANICS OF COASTAL LANDSLIDES AND THE INFLUENCE OF SLOPE PARAMETERS,
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
T. B. Edil, and L. E. Vallejo.
Engineering Geology, Vol 16, No 1/2, p 83-96, July 1980. 8 Fig, 1 Tab, 14 Ref.

Descriptors: *Landslides, *Lake shores, *Great lakes, *Beach erosion, Weathering, Slope stability, Lakes, Waves(Water), Erosion, Solifluction, Analytical techniques, Slopes, Slip-circle method, Groundwater, Water levels, Frost action, Seepage, Mass wasting, Coastal bluffs.

Shoreline erosion results in landslides and complex slope processes, under appropriate conditions, in unconsolidated materials forming the coastal bluffs. Shoreline erosion and bluff recession along most of the Great Lakes shoreline results in losses in millions of dollars annually. An understanding of bluff recession and the trends in the evolution of coastal bluffs is required for an evaluation of engineering and management solutions for the problems created. The factors effecting changes in bluff geometry include wave action, frost action, seepage effects, sheet wash, and weathering. An overview of the physical processes as they affect slope evolution, the available mechanical models, and the influence of slope parameters on the stability of the coastal bluffs were presented. The response of coastal slopes to the action of these factors was viewed as shallow failures and downslope transport as well as deep rotational slips. A distinction between the stability against deep slips which was termed as quasi-stability and the ultimate stability was made. The progress of slope evolution in coastal bluffs can be predicted with successive applications of the two-dimensional circular slip limit equilibrium analysis of slope stability using the effective stress method. The influence of slope parameters, namely, geometry (slope height and inclination), material properties (strength parameters and unit weight), and the relative position of the groundwater table on the limiting stability conditions of uniform slopes was presented based on such a limit equilibrium analysis. The relative influence of some of these parameters varies with slope height, and the slopes can be viewed as low and high slopes with a height of 25 m as an approximate demarcation between the two groups. (Humphreys-ISWS)
W80-06762

TEMPERATURE FINE-STRUCTURE OF LAKE MICHIGAN HYPOLIMNION,
Florida State Univ., Tallahassee. Dept. of Oceanography.
G. O. Marmorino, S. C. Danos, and J. S. Maki.
Limnology and Oceanography, Vol 25, No 4, p 680-699, July 1980. 11 Fig, 2 Tab, 34 Ref. NSF OCE 78-08992.

Descriptors: *Water temperature, *Hypolimnion, *Lake Michigan, *On-site investigations, Lakes,

On-site data collections, Dissolved oxygen, Silica, Profiles, Spatial distribution, Distribution patterns, On-site tests, Currents(Water), Methodology, Suspended solids, Ammonia, Conductivity, Bacteria, Density.

High-resolution temperature profiles from the hypolimnion of Lake Michigan in June and August 1978 showed the frequent occurrence of intrusive layers of thickness 10 m or less. Anomalously warm layers (delta T less than or equal to 0.1 C) seemed to extend horizontally for equal to or greater than 0.5 km and to persist at one location for approximately 0.5 day. Since temperatures were above maximum density values, these layers would have been hydrostatically unstable were it not for observed stabilizing gradients of dissolved silica. Interleaving of the layers, shear-induced turbulence, and stirring at the bottom resulted in various small-scale temperature structures. After an intense coastal upwelling event, a bottom layer 5-m thick was observed along the 100-m isobath in which temperatures and silica concentrations were nearly uniform and in which a value of at least 0.1 sq cm/s was calculated for the vertical eddy diffusivity. (Humphreys-ISWS)
W80-06769

THE AREAL HYPOLIMNETIC OXYGEN DEFICIT: AN EMPIRICAL TEST OF THE MODEL,
McGill Univ., Montreal (Quebec). Dept. of Biology.
R. J. Cornett, and F. H. Rigler.
Limnology and Oceanography, Vol 25, No 4, p 672-679, July 1980. 6 Fig, 5 Tab, 33 Ref.

Descriptors: *Model studies, *Lakes, *Dissolved oxygen, *Hypolimnion, On-site investigations, Data collections, Analysis, Phosphorus, Eutrophication, Secchi disks, Oxygen demand, Organic matter, Carbon, Primary productivity, Oxygen deficit.

The areal hypolimnetic oxygen deficit (AHOD) model was tested by examining the relationship between rates of hypolimnetic oxygen depletion and three measures of lake trophic status. Measurements of AHOD were positively correlated with the measured total phosphorus concentration and with annual 14C pelagic primary production and inversely correlated with mean summer Secchi depth. Because each of the correlations between AHOD and trophic status explained less than 45% of the observed variation in AHOD values, other factors must also influence the AHOD of a lake. Significant amounts of the residual variation were explained by including the mean depth of the lake and mean hypolimnetic temperature as additional independent variables in a multiple regression analysis. A lake with a thicker or warmer hypolimnion had a higher AHOD than a lake with a shallow or colder hypolimnion. The AHOD model was developed to eliminate the influence of lake morphometry on interlake comparisons of hypolimnetic oxygen depletion, but it does not do this and a new model must be developed. (Humphreys-ISWS)
W80-06770

THE CLASSIFICATION OF MIXED-LAYER DYNAMICS IN LAKES OF SMALL TO MEDIUM SIZE,
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
R. H. Spigel, and J. Imberger.
Journal of Physical Oceanography, Vol 10, No 7, p 1104-1121, July 1980. 10 Fig, 3 Tab, 47 Ref.

Descriptors: *Lakes, *Mixing, *Dynamics, *Model studies, Mathematical models, Classification, Winds, Stress, Entrainment, Waves(Water), Temperature, Water temperature, Stratification, Thermocline, Limnology, Mixed layers.

An analysis of the time scales of processes relevant to wind mixing in lakes indicated that the response of a lake to wind may be classified into four regimes with respect to thermocline deepening behavior, depending on the relative sizes of the parameters describing wind strength, basin size, and stratification. The dependence was described in terms of a mixed layer Richardson number and the aspect ratio of the mixed layer thickness to length. The classification was used to explain the diversity of phenomena reported in the literature for wind events in a number of different lakes and laboratory tanks which are either short enough or narrow enough for rotational effects to be unimportant. The classification was derived with reference to a two-layer, rectangular basin in the absence of Coriolis forces and surface heating. The classification was extended in a simple way to more realistic stratifications and basin shapes to predict the overall mixing features of a wind event. Response to wind varied from one in which entrainment proceeds very slowly and has negligible effect on baroclinic motions to one in which any stratification is rapidly destroyed by wind before baroclinic motions can occur. Between these two extremes entrainment and mean motions interacted through the production of turbulent kinetic energy by velocity shear at the base of the mixed layer. The nature of this interaction was investigated, and scales for velocity shear, stable interface thickness, and times for internal seiching, internal wave decay, and vertical and longitudinal mixing were developed. A computer algorithm parameterizing the effects of shear production on mixed layer deepening was described, based on the analysis presented. By incorporating this algorithm in a more comprehensive reservoir simulation model, DYRESM, effects of surface heating, realistic stratification, and complicated basin shape may be accounted for. Interaction between these effects and the wind deepening mechanism was described explicitly by the program logic. Results of a successful simulation by DYRESM for a season in the Wellington Reservoir, Western Australia, were discussed. (Sims-ISWS)
W80-06844

OBSERVED AND PREDICTED GREAT LAKES WINTER CIRCULATIONS,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
R. L. Pickett.
Journal of Physical Oceanography, Vol 10, No 7, p 1140-1145, July 1980. 4 Fig, 12 Ref.

Descriptors: *Water circulation, *Great Lakes, *Winds, *Model studies, Lake Ontario, Lake Huron, Lake Erie, Lake Superior, Mathematical models, Currents(Water), Lakes, Winter, Forecasting, Limnology.

Observed mean winter currents in Lakes Ontario and Huron were compared to predictions from a homogeneous, vertically integrated, steady-state model. If specific wind directions are selected to drive this model, the observed and predicted current patterns agree. The specific wind directions were chosen to maximize each lake's wind response. The agreement suggests that there is a mean wind-driven winter circulation in the Great Lakes, and that its pattern depends upon these specific wind directions. Based on these factors, winter circulations for Lakes Erie, Huron, and Superior were predicted. (Sims-ISWS)
W80-06846

FINITE ELEMENTS IN WATER RESOURCES, VOLUME 1.
For primary bibliographic entry see Field 2A.
W80-06858

FINITE ELEMENT SIMULATION OF ANISOTROPIC TURBULENT DIFFUSION IN LAKES,
Canada Centre for Inland Waters, Burlington (Ontario); and National Water Research Inst., Burlington (Ontario).
D. C. L. Lam.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol.), Mississippi University, Oxford, May 19-23,1980. p 3.20-3.35, 1980. 4 Fig, 3 Tab, 15 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Diffusion, *Lakes, *Turbulent flow, *Model studies, Mathematical models, Finite element analysis, Eddies, Thermal pollution, Water pollution, Path of pollutants, Mixing, Thermocline, Limnology.

The turbulent diffusion in the lake environment has long been observed to be strongly influenced by the spatial orientation of the physical flow field and the thermal regime. By separating the more organized motions from the random components of the instantaneous flow, it is possible to describe the transport and diffusion phenomena by means of a deterministic mathematical model, using turbulent diffusion closure laws. In the case of effluent plumes in the farfield areas of the coastal zone, the horizontal diffusion is often regarded as a nonlinear process affected by the size of the turbulent eddies and the length-scale of the plume. In the case of the vertical diffusion, the process is governed by the balance of wind mixing and buoyancy effect. Based on semi-empirical hypotheses, the closure formula for the turbulent eddy diffusivity is often expressed in terms of the spatial integrals or derivatives of the dependent variables. Mathematically, implementation of these nonlinear expressions require special techniques to preserve the physical and spatial characteristics of the environmental turbulence. (See also W80-06858) (Sims-ISWS)
W80-06887

FINITE ELEMENTS IN WATER RESOURCES, VOLUME 2,
For primary bibliographic entry see Field 2A.
W80-06894

FINITE ELEMENT ANALYSIS OF DEPTH VARYING FLOW IN LAKES AND COASTAL REGIONS,
Vermont Univ., Burlington. Dept. of Civil Engineering.
J. P. Laible.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 5.72-5.91, 1980. 10 Fig, 5 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Finite element analysis, *Mathematical models, *Lakes, *Estuaries, *Flow, Coasts, Analytical techniques, Analysis, Bays, Methodology, Model studies, Equations, Momentum equation, Continuity equation, Boundaries(Surfaces), Tidal waters, Velocity, Profiles.

This paper presented a finite element model for depth varying flow in shallow bays, estuaries and coastal regions. Some conclusions and observations about the results were: (1) The horizontal velocity field was determined as a function of t, x, y and depth z as opposed to the vertically integrated models that yield depth averaged flows. (2) The primitive form of the hydrodynamic equations was used, and the velocities were obtained directly as it is not necessary to obtain derivatives of potential fields. This avoids the difficulty of discontinuity of velocities at element boundaries. In this model, there are five unknowns at each node; the top and bottom velocities in the x and y direction, and the change in surface elevation. (3) The nonlinear convective terms were retained in their original form with no linearization. (4) Different bottom friction laws were easily implemented. The model only considers the flow outside the small bottom boundary layer. The suitability of any friction law (and the value of its associated coefficients) can be ascertained by acquiring field data in the form of flow profiles. (5) A depth varying eddy viscosity may be used and will allow greater flexibility for calibrating the model from field data. (6) A wide range of eddy viscosity and bottom friction values can be used. (7) A comparison of the finite element method results with a semi-analytic solution of a one-dimensional problem indicates a good correlation. The cubic approximation of the velocity as a function of depth provides a good fit to the closed form solution. (8) Large coefficient matrices are not generated. The coefficients for each node are stored and called at each time step. (9) A split time step algorithm for time integration was used. The time step, however, remains limited by the critical value of delta X/sq root of (2gh). CPU time was typically 3-4 times longer than for the comparable

vertical integrated model. (10) Integration by parts was not used for the second order terms. As a result, the horizontal eddy viscosity terms will be constant over an element. (See also W80-06894) (Humphreys-ISWS)
W80-06909

APPLICATION OF THE FINITE ELEMENT METHOD TO VERTICALLY STRATIFIED HYDRODYNAMIC FLOW AND WATER QUALITY,
Hydrologic Engineering Center, Davis, CA.
R. C. MacArthur, and W. R. Norton.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 5.92-5.102, 1980. 4 Fig, 1 Tab, 1 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Finite element analysis, *Water quality, *Mathematical models, *Stratified flow, *Lakes, *Missouri, Analytical techniques, Model studies, Open channel flow, Water temperature, Velocity, Profiles, Hydrodynamics, Flow, Dissolved oxygen, Phytoplankton, Laboratory tests, Path of pollutants, *Lake Taneycomo(MO).

RMA-7 is a two-dimensional mathematical model that describes the behavior of velocity, pressure, temperature and dissolved oxygen in the vertical plane with homogeneity assumed in the third (lateral) direction; the model will accommodate width gradients in both the X and Y directions. Formulated on the classical concepts of conservation of mass, momentum, and energy, it is a somewhat unusual model as it retains the complete vertical momentum equation and does not make the assumption that pressure must be hydrostatic. This model was applied to two prototype stratified flow situations. In each application a stratified flow was simulated as a result of density differences arising from temperature gradients. In the second example, dissolved oxygen, BOD, and phytoplankton were also routed in accordance with the overall flow fields. Based on the data presented, it seems reasonable to conclude that: (1) The finite element method in general and RMA-7 in particular are capable of simulating vertically stratified two-dimensional flow; (2) The proper definition of eddy viscosity and dispersion coefficients is essential to proper model operation, and there may be transferability of values from problem to problem if element size and distortion are accounted for; and (3) RMA-7 appears to give reasonable answers, but currently it is not possible to evaluate its accuracy in relation to velocity due to a lack of prototype data; initial comparisons of temperature and dissolved data are promising and will improve as calibrations become more rigorous and quantified. (See also W80-06894) (Humphreys-ISWS)
W80-06910

ON FINITE ELEMENT ANALYSIS OF NON-LINEAR HEAT TRANSFER WITH PHASE CHANGES,
Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 2C.
W80-06926

2I. Water In Plants

RESPONSE OF SEMIARID GRASSLAND SITES TO NITROGEN FERTILIZATION: I. PLANT GROWTH AND WATER USE,
Science and Education Administration, Lincoln, NE.
J. F. Power.
Soil Science Society of America Journal, Vol 44, No 3, p 545-550, May-June 1980. 2 Fig, 3 Tab, 15 Ref.

Descriptors: *Plant growth, *Water utilization, *Evapotranspiration, *Grasslands, *North Dakota, Soil water, Fertilization, Nitrogen compounds, Crop response, Bromegrass, Wheatgrasses, On-site investigations, Ecosystems.

Eight rate-of-N-fertilizer experiments were conducted for 5 or 6 years on established perennial grass sites near Mandan, North Dakota. Experiments were conducted within essentially the same precipitation and temperature regimes on sites differing in soil type, exposure, and grass species to determine their influence on N response. Aboveground vegetation response to N fertilization depended primarily upon species--smooth bromegrass (Bromus inermis) was generally more responsive than crested wheatgrass (Agropyron desertorum) or native mixed prairie. No consistent patterns of root biomass response to N fertilization were obvious. At some sites or in certain years root biomass responses were fairly consistent, whereas at other sites or in other years, little response to N occurred. Water use efficiency (WUE) was greatest for bromegrass and least for native grasses, and was generally increased by N fertilization. WUE increased as above-ground growth increased, whether as a result of N fertilization or because of less evaporation at more protected sites. Cumulative dry matter response to N fertilization was highly correlated with cumulative fertilizer N added, with a different curvilinear relationship for each site. These results indicated that the magnitude of fertilizer N responses by perennial grasslands is site specific. Consequently interpretations of fertilizer experiments conducted on only one soil type or with only one species must be interpreted with caution. (Humphreys-ISWS)
W80-06488

LARGE-SCALE OPERATIONS MANAGEMENT TEST OF USE OF THE WHITE AMUR FOR CONTROL OF PROBLEM AQUATIC PLANTS; REPORT 1, BASELINE STUDIES; VOLUME I: THE AQUATIC MACROPHYTES OF LAKE CONWAY, FLORIDA,
Florida Dept. of Natural Resources, Tallahassee. Bureau of Aquatic Plant Research and Control.
L. E. Nall, and J. D. Schardt.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A057345, Price codes; A07 in paper copy, A01 in microfiche. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, Technical Report A-78-2, June 1978. 122 p, 15 Tab, 82 Ref, 7 Append.

Descriptors: *Aquatic weed control, *Aquatic plants, Baseline studies, *Environmental effects, Ecology, Fish, Lakes, *White amur, Lake Conway(FL).

Presented are the results of studies intended to provide baseline information in preparation for measuring the effect of the white amur on the aquatic vegetation of Lake Conway, Florida. The sponsors hope to assess the environmental impact of the fish, evaluate its ability to control vegetation, develop ecological models to predict the effect of the fish on other systems, and devise a management plan for large-scale use. Included herein are (1) descriptions of the methods of and materials used in aquatic plant research in Lake Conway, (2) results and observations made during and subsequent to the test period, and (3) a literature review. Appendix A presents the Stratified Random Sample Results; Appendix B, Numerical Summary of Transect Results; Appendix C, Graphs of Selected Transect Results; Appendix D, Monthly Standing Crop Changes; Appendix E, Numerical Summary of Permanent Plot Data; Appendix F, Graphs of Selected Permanent Plot Data; and Appendix G, The Approximate Distribution of the Dominant Plants in Lake Conway. (WES)
W80-06541

HYDROLOGIC CHARACTERISTICS OF WISCONSIN'S WETLANDS AND THEIR INFLUENCE ON FLOODS, STREAM FLOW, AND SEDIMENT,
Geological Survey, Madison, WI. Water Resources Div.
R. P. Novitzki.
In: Wetland Functions and Values: The State of Our Understanding; American Water Resources Association, p 377-388, November 1978. 11 Fig, 1 Tab, 10 Ref.

Descriptors: *Hydrologic budget, *Wetlands, *Wisconsin, *Effects, Floods, Streamflow, Sediment yield, Soil-water-plant relationships, Slopes, Flood flow, Base flow, Groundwater, Surface waters.

This report describes the hydrologic characteristics of Wisconsin's wetlands and their effect on floodflows and base flows. Wetlands occur in depressions and on slopes, and may be in contact with ground water or totally surface-water supported. Wisconsin's wetlands can be classified as surface-water depression, ground-water depression, surface-water slope, or ground-water slope. Throughout the State floodflows are 80% lower, springtime streamflows 40% higher, and fall base flows 40% lower in basins with 40% lake and wetland area than in basins with no lake and wetland area. In the north-central third of the State sediment yields are 90% lower in basins with 40% lake and wetland area than in basins with no lake and wetland area. (USGS)
W80-06595

ESTIMATING WATER USED BY IRRIGATED CORN IN WEST CENTRAL MINNESOTA,
Science and Education Administration, Morris, MN. North Central Soil Conservation Research Lab.
For primary bibliographic entry see Field 3F.
W80-06840

GEOTHERMAL AREAS IN NEVADA - THE DISTRIBUTION OF VASCULAR PLANTS NEAR THE THERMAL SPRINGS SURVEYED,
Nevada Univ. System, Reno. Desert Research Inst.
J. Freeman, and J. L. Mahoney.
Mentzelia The Journal of the Northern Nevada Native Plant Society, No 3, p 8-14, 1977, 3 Fig, 3 Tab, 11 Ref. OWRT-A-077-NEV (1), 14-34-0001-7060.

Descriptors: *Geothermal studies, *Vascular plants, *Thermal springs, Ecological distribution, Deserts, Environmental control, Baseline floral survey, Energy development, Thermal power, *Nevada, Great Basin(NV), Endangered Flora.

Potential energy-related development of Nevada's geothermal areas requires an assessment of the associated biota. This research documents the species, composition and relative abundance of vascular plants inhabiting thirteen thermal areas throughout Nevada. One hundred twenty-five species representing 50 plant families were collected. The most interesting plant found, A stragolus lentiginosus Dougl. var sesquimetrolis (Rydb.) Barneby, was previously believed to be extinct within the continental United States. The current distribution of this species is presented; due to its extremely restricted distribution, protection of its habitat is essential. Differentiation was made between the flora of warm springs (generally in Southern Nevada) and hot springs (generally in Central and Northern Nevada). This study provides a baseline floral survey of selected geothermal sites which can be used to evaluate potential future environmental perturbations.
W80-06936

2J. Erosion and Sedimentation

CLUTHA FLOOD OF OCTOBER 1978,
Ministry of Works and Development, Wellington (New Zealand). Power Div.
For primary bibliographic entry see Field 2A.
W80-06479

NUMERICAL MODELLING OF SUSPENDED SEDIMENTS,
Thessaloniki Univ., Salonika (Greece). Dept. of Hydraulics.
C. Koutitas, and B. O'Connor.
Advances in Water Resources, Vol 3, No 2, p 51-57, June 1980. 8 Fig, 11 Ref.

Descriptors: *Mathematical models, *Boundary processes, *Suspended load, Suspended solids,

Mathematical studies, Equations, Analytical techniques, Analysis, Finite element analysis, Sediment transport, Numerical analysis, Diffusion, Laboratory tests, Alluvial channels, *Suspended sediments, Galerkin error minimization procedure.

The turbulent advection-diffusion mathematical model in three-dimensional space was solved by a mixed finite element finite difference method. Linear finite elements in the vertical direction and central finite differences in the horizontal directions were used coupled with the Galerkin error minimization procedure. The integration in time was performed in fractional steps (one explicit one implicit) by splitting the differential operator. The method was illustrated by application to the three-dimensional movement of suspended sediment. Its accuracy was checked by comparison to analytical solutions and its efficiency was gaged relative to finite elements and implicit finite difference solutions for two-dimensional suspended sediment transport over a dredged channel. (Lee-ISWS)
W80-06485

SOIL AGGREGATES AND PRIMARY PARTICLES TRANSPORTED IN RILL AND INTERRIL FLOW,
Science and Education Administration, Columbia, MO.
E. E. Alberts, W. C. Moldenhauer, and G. R. Foster.
Soil Science Society of America Journal, Vol 44, No 3, p 590-595, May-June 1980. 1 Fig, 9 Tab, 21 Ref.

Descriptors: *Soil erosion, *Rill erosion, *Model studies, *Soil management, *Indiana, On-site tests, Runoff, Sediment transport, Soils, Sands, Silts, Clays, Organic matter, Soil density, Flow, Discharge(Water), Erosion rates, Particle size, Rill flow, Interrill flow.

The size distribution of soil particles detached and transported in rill and interrill flow was determined on a silt loam soil in northcentral Indiana. Eroded soil was separated by field and laboratory sieving into greater than 2-, 2- to 1-, 1- to 0.5-, 0.5- to 0.21-, 0.21- to 0.05-, and less than 0.05-mm size classes. The amount of primary clay (less than 0.002 mm) transported as discrete particles in rill and interrill flow was also determined. Large differences were found in the size of soil aggregates and primary particles in rill and interrill sediment. Rill flow transported a greater proportion of larger particles as compared with interrill flow because of basic differences in the detachment and transport mechanisms. Less than 5% of the rill and interrill sediment was composed of primary clays, indicating that most eroded clay was transported within soil aggregates. The primary particle composition of the eroded aggregates was also determined. For all sizes less than 0.05 mm, the percentage of sand in rill and interrill sediment was considerably higher than that in the matrix soil. The high sand content decreased the percentage of silt in some size classes more than the percentage of clay, indicating that primary clays may either flocculate or adsorb to the surfaces of larger aggregates during transport. Water was added to the top of preformed rills at several rates to simulate various upland slope lengths. Discharge and rill erosion rates were not related for this soil that had not been tilled or cropped for 1 year. (Humphreys-ISWS)
W80-06490

VERTICAL MIXING OF LAKE SEDIMENTS BY TUBIFICID OLIGOCHAETES,
California Univ., Santa Barbara. Dept. of Mechanical and Environmental Engineering.
For primary bibliographic entry see Field 2H.
W80-06500

SEDIMENT DEPOSITION IN THE WHITE RIVER RESERVOIR, NORTHWESTERN WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
W. G. Batten, and S. M. Hindall.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $6.00 in paper copy, $4.00 in microfiche. Geological Survey open-file report 79-1330, November 1979. 34 p, 13 Fig, 1 Plate, 3 Tab, 12 Ref.

Descriptors: *Sediment transport, *Erosion, *Streams, *Sediment yield, *Wisconsin, Reservoirs, Sediment distribution, Reservoir silting, Suspended load, Particle size, Sedimentation rates, Bed load, Gaging stations, Data collections, *White River Reservoir(WI), *Northwestern Wisconsin.

Sediment transport in the White River and deposition in the White River Reservoir were studied to determine past erosion rates in the red-clay area of northwestern Wisconsin. The original reservoir capacity and volume of deposited sediment were calculated to be 815 acre-feet and 487 acre-feet, respectively. Analyses of deposited sediment averaged 43 percent sand, 40 percent silt, and 17 percent clay. The gross rate of deposition was about 7.0 acre-feet per year over the reservoir history, 1907-76. The rate for the period 1963-76 was 5.7 acre-feet per year based on Cesium-137 dating. Presently, the reservoir traps only sand and some silt-sized sediment. Clay-sized material (over 80 percent of suspended sediment presently entering the reservoir) pass through without being deposited. Based on limited data, the average annual sediment yield for the 279 square mile drainage area above the reservoir was about 50 tons per square mile or 8 acre-feet per year. Almost all of this sediment is derived from steep unvegetated streambanks in a red-clay area comprising less than 10 percent of the total drainage area. (USGS)
W80-06532

GENERAL STUDY OF THE MODIFIED EINSTEIN METHOD OF COMPUTING TOTAL SEDIMENT DISCHARGE,
Geological Survey, Menlo Park, CA. Water Resources Div.
D. E. Burkham, and D. R. Dawdy.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $1.80. Geological Survey Water-Supply Paper 2066, 1980. 67 p, 10 Fig, 1 Tab, 22 Ref.

Descriptors: *Sediment discharge, *Equations, *Computer programs, *Methodology, Correlation analysis, Suspended load, *Einstein method(Modified).

The modified Einstein procedure was revised by applying corrections to two equations and by replacing two equations. The revision was made because D65 was used directly in the modified Einstein procedure to represent the equivalent sand roughness, ks, whereas a much larger size apparently should have been used. For this study, 5.5 D65, an average value based on a best fit for data for several sites, was used. Improvement is indicated by the revision because the corrections of pertinent equations eliminated some of the empirical adjustments contained in the modified Einstein procedure. The approximate standard error of estimate for total sediment discharge determined for five streams is 22 percent for the modified and revised modified Einstein procedures. The revised modified Einstein procedure gives shear velocities that are significantly larger and x values that are significantly smaller than the corresponding values computed using the modified Einstein procedure. The ratio of shear velocity for the revised modified Einstein procedure ranges from 9.52 to 1.28 for stream velocities ranging from 0.50 to 15 feet per second. For the 292 data sets used in testing the two procedures, the value x ranged from 1.00 to 1.14 for the revised modified Einstein procedure and from 1.00 to 1.62, the maximum value possible, for the modified Einstein procedure. The value of x is 1 for fully turbulent flow. (USGS)
W80-06593

THE PHYSICAL PROPERTIES OF SOME ERODED SOILS OF SOUTHEASTERN NIGERIA,
Nigeria Univ., Nsukka. Dept. of Soil Science.
M. E. Obi, and B. O. Asiegbu.
Soil Science, Vol 130, No 1, p 39-48, July 1980. 7 Fig, 6 Tab, 9 Ref.

Descriptors: *Soil erosion, *Physical properties, *Africa, *Erosion control, Data collections, Permeability, Hydraulic conductivity, Porosity, Infiltration, On-site investigations, Laboratory tests, Soil profiles, Soil density, Foreign research, Foreign countries, *Nigeria.

The physical properties of some eroded soils of the rain forest and savanna zones of southeastern Nigeria were investigated. These soils are on slopes of 4 to 22%, and the degree of erosion varies from very slight to catastrophic. Texturally, the top soils are sand and loamy sand, and most profiles are uniform to considerable depths. Total soil porosities range from 40 to 61%, with macropores constituting 35 to 60%. Infiltration rates range from 10.1 to 357.1 cm per hour, and saturated hydraulic conductivities of the top layers range from 7.1 to 33.1 cm per hour. Water release curves showed considerable loss of water (41 to 67%) between 0 and 80 cm of water tension, in conformity with the textural and organic matter status of the soils. An erodibility rating curve showed the Onicha-Mbaise and Agulu soils to be most erodible and the Nsukka soils to be most stable. The implications of these findings for soil management practices and cropping systems were discussed. Exhibiting remarkably good physical properties, in particular the capacity for high rainfall acceptance, it appears that most of the soils investigated can be stabilized primarily by adequate vegetative cover. (Humphreys-ISWS)
W80-06615

CHEMICAL YIELDS IN RUNOFF, AND DENUDATION IN A SMALL ARABLE CATCHMENT, EAST DEVON, ENGLAND,
Lanchester Polytechnic, Coventry (England). Dept. of Geography.
I. D. L. Foster.
Journal of Hydrology, Vol 47, No 3/4, p 349-368, July 1980. 4 Fig, 10 Tab, 53 Ref.

Descriptors: *Erosion, *Chemicals, *Runoff, *Sampling, *Model studies, Mathematical models, Discharge(Water), Watersheds(Basins), Nutrients, Dissolved solids, Solutes, Hydrogen ion concentration, Electrical conductance, Rating curves, Streamflow, Water quality, Chemical denudation.

The calculation of rates of chemical denudation on the basis of streamflow data is subject to a variety of error sources, ranging from the initial sampling and chemical analysis scheme, to the estimation of the nondenudational component of streamflow loss. Most variability in load estimates, based on rating curves, was shown to occur at the monthly level which has serious implications for determining detailed nutrient budgets on this basis. Implications for rates of denudation appear less significant since annual estimates smooth out the high degree of monthly variability. Of great importance in the investigation of process rates is the sampling period length, since a high degree of variability occurs between years which simply reflects variations in the hydrological regime. (Sims-ISWS)
W80-06633

SEDIMENTATION IN THE FRASER RIVER AND ITS ESTUARY, SOUTHWESTERN BRITISH COLUMBIA (CANADA),
Geological Survey of Canada, Vancouver (British Columbia).
J. D. Milliman.
Estuarine and Coastal Marine Science, Vol 10, No 6, p 609-633, June 1980. 17 Fig, 4 Tab, 18 Ref.

Descriptors: *Estuaries, *Rivers, *Sediment transport, *Canada, Suspended solids, Sands, Silts, Clays, Variability, Seasonal, Tides, Tidal effects, Tidal waters, Coasts, Sediments, Dredging, Sedimentology, *Fraser River (British Columbia), *British Columbia.

The Fraser River, the largest river (in terms of both water and sediment discharge) reaching the west coast of Canada, is a sand-dominated river in which most sediment transport occurs during freshet in late spring and early summer. More than

half the sediment discharged during this 2-3 month period is sand. Throughout the rest of the year, the river is characterized by lower flow and low suspended sediment concentrations (primarily silt and clay); net offshore transport during these months is slight, and near-bottom transport appears to be landward. The dominance of sand transport in the Fraser results in an estuarine depositional regime quite different from most mud-dominated rivers and estuaries. Although most sediment in the river is carried in suspension, about 40% of the sand (20% of the total load) settles from suspension in the upper estuary and most of the rest settles prior to reaching the lower estuary. In a natural situation, much of the river sand probably would continue moving seaward as bed load, as suggested by the prevalence of migrating sand waves in the middle estuary during freshet. Longshore drift of this sand has built tidal flats that now dominate the nearshore environment. Dredging of river channels removes an appreciable part of the total annual sand load. Jetties across intertidal flats and at the river mouth have interrupted longshore transport and increased resuspension of sand in the outer estuary by channelizing flow. All of these factors should combine in shifting tidal flats and adjacent shoreline from their natural state. (Sims-ISWS)
W80-06653

THE DESIGN OF SEDIMENT BASINS,
Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4D.
W80-06671

RESIDUE AND TILLAGE EFFECTS ON SCS RUNOFF CURVE NUMBERS,
Science and Education Administration, Beltsville, MD.
For primary bibliographic entry see Field 2E.
W80-06672

SEA RESEARCH PROGRAM FOR CHANNEL STABILITY AND GULLY CONTROL,
Science and Education Administration, Oxford, MS.
For primary bibliographic entry see Field 4D.
W80-06673

PROPOSED CRITERIA FOR INTERPRETING STABILITY OF LAKESHORE BLUFFS,
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2H.
W80-06761

MECHANICS OF COASTAL LANDSLIDES AND THE INFLUENCE OF SLOPE PARAMETERS,
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2H.
W80-06762

OPEN CHANNEL FLOW WITH SUSPENDED SEDIMENTS,
Hokkaido Univ., Sapporo (Japan). Dept. of Civil Engineering.
T. Itakura, and T. Kishi.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY8, Proceedings Paper 15650, p 1325-1343, August 1980. 9 Fig, 26 Ref, 2 Append.

Descriptors: *Open channel flow, Sediments, *Sediment transport, *Suspended solids, *Model studies, Mathematical models, Turbulence, Velocity, Flow, Channel flow, Mixing, Disperison, Distribution patterns, Particle size, Hydraulics, Hydrodynamics, Sedimentology.

Characteristics of open channel flow with suspended sediments were theoretically investigated introducing a theory based on the Monin-Obukhov length. First, a velocity distribution equation based on the theory showed good agreement with the measured velocity distribution. Second, the hydraulic resistance and the distribution of suspended sediment concentration observed in experiments were explained theoretically. Third, a transport rate formula for suspended sediments, in which 'classical equations' were included as a particular case, was obtained; and this formula, in cooperation with a reference concentration derived in the present study, showed agreement with experimental results. Finally, the critical condition for deposition of suspended particles and the collapse of turbulence were derived and verified by experiments. (Sims-ISWS)
W80-06820

VISUALIZATION OF SEPARATION OVER SAND WAVES,
Technical Univ. of Istanbul (Turkey). Dept. of Civil Engineering.
M. E. Karahan, and A. W. Peterson.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY8, Proceedings Paper 15652, p 1345-1352, August 1980. 5 Fig, 13 Ref, 2 Append.

Descriptors: *Flow separation, *Sand waves, *Model studies, *Hydraulic models, Flow, Flumes, Laboratory tests, Equipment, Instrumentation, Optical properties, Sands, Beds, Froude number, Reynolds number, Data processing, Sediment transport, Sedimentology, Hydraulics, Birefringence, Polariscopes, Polarization, Visualization, Flow visualization.

Flow pattern and separation over dune-shaped beds have been observed by streaming birefringence. By this visual observation, qualitative measurements were carried out, and the variations of the separation zone length with the Froude and Reynolds numbers of the flow were established. At low Froude numbers, the length of separation zone is proportional by the inverse of Froude number. If the Froude number of the flow is greater than 0.2, there is no significant change in the separation zone length, and the ratio of the separation zone length to the height of dunes takes 0.32 constant value. This ratio also is a function of flow Reynolds number in laminar boundary layer, and decreases with increasing Reynolds numbers. In the case of turbulent boundary layer, this ratio is independent of Reynolds number. (Sims-ISWS)
W80-06821

SHORT STATISTICAL ANALYSIS OF TOTAL LOAD CONCENTRATION,
Punjab Agricultural Univ., Ludhiana (India). Dept. of Civil Engineering.
J. P. Soni.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY8, Technical Note, p 1383-1389, August 1980. 4 Fig, 3 Tab, 4 Ref, 1 Append.

Descriptors: *Sediment transport, *Laboratory tests, *Sediment load, *Uniform flow, Analytical techniques, Analysis, Testing procedures, Statistical methods, Sediment discharge, Data collections, Particle size, Sediment concentration, Standard deviation.

Recently Willis and Bolton conducted uniform flow experiments to collect data on total sediment concentrations for the sediment size having a median diameter of 0.54 mm. They have correlated these concentrations with statistical parameters like mean, standard deviation, etc. The author performed a series of uniform flow experiments with sediment. Twenty-three uniform flow experiments were conducted in a 200 mm wide, 500 mm deep, and 30 m long recirculatory tilting flume. The sand forming the bed had a median sieve diameter of 0.32 mm and a geometric standard deviation of 1.30. The grain size distribution of the sand was tabulated. The specific gravity of the sand was 2.65. Mean concentration C and the standard deviation of the total load concentration fluctuations are both closely related to the Froude number squared of flow. The mean concentration was found to be 3.125 times the standard deviation for the sediment having median particle diameter of 0.32 mm, indicating an extreme variation in the concentration data. (See also W79-05535) (Humphreys-ISWS)
W80-06824

SAND MOTION INITIATION BY WATER WAVES: TWO ASYMPTOTES,
Coastal Engineering Research Center, Fort Belvoir, VA.
R. J. Hallermeier.
Journal of the Waterway, Port, Coastal and Ocean Division, American Society of Civil Engineers, Vol 106, No WW3, Proceedings Paper 15603, p 299-318, August 1980. 5 Fig, 2 Tab, 59 Ref, 2 Append.

Descriptors: *Erosion, *Sands, *Coastal engineering, *Model studies, Mathematical models, Sand waves, Waves(Water), Velocity, Shear, Shear drag, Sediments, Sedimentation, Sedimentology, Beaches, Coasts.

The new calculation procedure for sand motion initiation on a level bed in oscillatory flow simplifies the Shields criterion adopted from steady flow and agrees better with available measurements. For fine sand and high flow frequency, published laboratory measurements agree with a model of motion initiation by threshold drag force on a grain in a laminarly shearing boundary layer. For coarse sand and low flow frequency, measurements agree with another model: a threshold flow energy above a thoroughly mixed boundary layer. The unified criterion presented predicts critical peak near-bed velocities between 10 cm/s and 50 cm/s (4 in./sec and 20 in./sec) in + or - 10 % agreement with a majority of adequately documented results for quartz sand in water. Critical velocity is determined by sand diameter, ratio of sand to fluid density, oscillation frequency, and to a lesser extent fluid viscosity. The effect of oscillation frequency vanishes for usual ocean situations, but not for wave-tank conditions. Needs for additional test data were pointed out. (Sims-ISWS)
W80-06829

IMPACT OF GRAVEL MINING ON RIVER SYSTEM STABILITY,
Military Academy, West Point, NY.
P. F. Lagasse, B. R. Winkley, and D. B. Simons.
Journal of the Waterway, Port, Coastal and Ocean Division, American Society of Civil Engineers, Vol 106, No WW3, Proceedings Paper 15643, p 389-404, August 1980. 11 Fig, 35 Ref, 1 Append.

Descriptors: *Gravels, *Mining, *Effects, *Stability, *Rivers, On-site investigations, Erosion, Sedimentation, Stream stabilization, Sediments, Particle size, Quarries, Dredging, Inland waterways, Channel morphology, Potamology, Mississippi River(MS).

Data from the Lower Mississippi River were presented and analyzed relative to trends which may be attributed, in part, to the removal of the gravel armor from the bed of the river by gravel mining. A significant change with time of both the size and gradation of the bed material of the Lower Mississippi River was documented. The data presented indicated a possible relationship between gravel mining and the development of divided flow reaches. While the available data was not sufficient to establish a direct cause-and-effect relationship between gravel mining and river system instability, the correlation was sufficient to serve as a warning of a potentially serious problem. The indiscriminate removal of gravel from river beds may be activating far-reaching changes in system morphology. (Sims-ISWS)
W80-06833

A FINITE ELEMENT WATERSHED MODEL TO PREDICT STORM HYDROGRAPHS, SEDIMENT EROSION AND TRANSPORT,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W80-06922

A DATA MANAGEMENT SYSTEM FOR FINITE ELEMENT SEDIMENT TRANSPORT MODELS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab. Ha.
For primary bibliographic entry see Field 7C.
W80-06923

FINITE ELEMENT MODELS IN A HYBRID MODEL STUDY OF ESTUARINE SEDIMENTATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 2L.
W80-06924

2K. Chemical Processes

EFFECT OF EXCHANGEABLE SODIUM PERCENTAGE, CATION EXCHANGE CAPACITY, AND SOIL SOLUTION CONCENTRATION ON SOIL ELECTRICAL CONDUCTIVITY,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
I. Shainberg, J. D. Rhoades, and R. J. Prather.
Soil Science Society of America Journal, Vol 44, No 3, p 469-473, May-June 1980. 4 Fig, 3 Tab, 14 Ref.

Descriptors: *Soil physical properties, *Cation exchange, *Conductivity, *Saline soils, Soils, Electrical conductance, Laboratory tests, Methodology, Analytical techniques, Salinity, Soil water, Sodium, Sands, Silts, Clays, Kaolinite, Montmorillonite, Mica, Vermiculite.

The electrical conductivity of eight soils was measured as a function of the solution electrical conductivity over a wide range of salt concentration and salt composition. The soils electrical conductivity in the low range of salt concentration (less than 2-3 mmho/cm). In the higher salt concentration range, straight line relationships were obtained. The shape of the curves was explained by the inclusion of a solid-water in series element in the conductance model. The effect of the soil exchangeable sodium percentage on the electrical conductivity curve parameters is slight and is not significant when the electrical conductivity method is used to survey soil salinity. However, for measurements of solute concentrations in nonsaline soils, deviations from linearity are significant and the full relationship developed should be used. (See also W77-04250) (Humphreys-ISWS)
W80-06487

ANALYSES OF WATER, CORE MATERIAL, AND ELUTRIATE SAMPLES COLLECTED NEAR SICILY ISLAND, LOUISIANA (SICILY ISLAND AREA LEVEE PROJECT),
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 8B.
W80-06517

GROUND-WATER QUALITY IN SELECTED AREAS OF WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
S. M. Hindall.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $3.00 in paper copy, $4.00 in microfiche. Geological Survey open-file report 79-1594 (WRI), December 1979. 20 p, 8 Ref.

Descriptors: *Water quality, *Groundwater, *Wisconsin, *Water wells, Water analysis, Water chemistry, Water quality standards.

Analysis of 2,071 ground-water samples from 970 wells throughout Wisconsin indicate large variations in ground-water quality. Ground water in Wisconsin is generally suitable for most uses, but in some areas concentrations of chemical constituents exceed recommended drinking-water standards. Iron, manganese, and nitrate commonly exceed recommended drinking-water standards and dissolved solids, sulfate, heavy metals, and phenolic materials may present local problems. (USGS)
W80-06518

DETAILS OF HYDROCHEMICAL VARIATIONS IN FLOWING WELLS,
Birmingham Univ. (England). Dept. of Geological Sciences.
For primary bibliographic entry see Field 2F.
W80-06602

2L. Estuaries

TRIHALOMETHANE LEVELS IN PUBLIC WATER SUPPLIES DRAWN FROM THE SACRAMENTO RIVER SYSTEM,
California Dept. of Health Services, Berkeley.
For primary bibliographic entry see Field 5B.
W80-06493

THE NUMERICAL MODELLING OF STORM SURGES IN THE BAY OF BENGAL,
Reading Univ. (England). Dept. of Meteorology.
B. Johns, and M. A. Ali.
Quarterly Journal of the Royal Meteorological Society, Vol 106, No 447, p 1-18, January 1980. 13 Fig, 11 Ref.

Descriptors: *Storm surge, *Tropical cyclones, *Model studies, Mathematical models, Coasts, Rivers, Tidal waters, Estuaries, Tides, Storms, Equations, Computer models, Analytical techniques, Weather, Floods, *Bay of Bengal.

A numerical model was developed for the simulation of surges generated by a tropical cyclone in the Bay of Bengal. The analysis area extends from approximately 11 deg N to 22 deg N, and, in the northeastern sector of the Bay includes a representation of the Ganges-Brahmaputra-Meghna river system in Bangladesh. The extent of the analysis area allowed three days of the surge-generating capacity of a cyclone originating in the southern Indian Ocean to be recorded before landfall at the Bangladesh coast. The incorporation of the river system permitted a potentially deep inland penetration of surges originating in the Bay. The model is non-linear which allows a determination of the interactive effect between surge and the astronomical tide. Numerical experiments were described that relate to the change in surge response resulting from a change in the cyclone track during the 24 hours preceding landfall. An account was given of the interaction between surge and tide in the Bay and the river system. (Sims-ISWS)
W80-06498

SATELLITE OBSERVATIONS OF A NUTRIENT UPWELLING OFF THE COAST OF CALIFORNIA,
Naval Postgraduate School, Monterey, CA. Dept. of Oceanography.
E. D. Traganza, D. A. Nestor, and A. K. McDonald.
Journal of Geophysical Research, Vol 85, No C7, p 4101-4106, July 20, 1980. 7 Fig, 11 Ref. ONR 5747, CODE 480.

Descriptors: *Upwelling, *Coasts, *California, *Remote sensing, *Nutrients, Satellites(Artificial), Mixing, Oceans, Surface waters, Chemical analysis, Water quality, On-site investigations, Phosphates, Nitrates, Oceanography.

Satellite thermal imagery was combined with automated chemical analysis of surface waters off central California to detect and better understand a 'nutrient upwelling' entering the California Current system. While thermal surface water features have been mapped successfully from satellites for a number of years, the relationship of satellite thermal imagery to nutrients, such as nitrates and phosphates, has not been established. As a result of such efforts, satellite remote sensors may help to explain the relationship between chemical mesoscale and pelagic ecosystems of the ocean. Viewed together with the satellite images, the in situ data suggest that nutrient cells may form when a concentrated pulse of upwelled water provides an initial thermochemical mesoscale structure. As a result, sharp gradients or chemical fronts and thermal fronts are formed. It is possible that nutrient cells coincided with thermal eddies observed in earlier satellite images as reasoned when CalCOFI data were compared with infrared images of the California Current system. However, while the correlation of 'satellite temperatures' with in situ temperatures may hold in all cases, correlations with chemical concentrations will depend on the initial conditions of the source water and subsequent changes that occur as a result of processes of advection, diffusion, mixing, heat transfer, salt transfer, and biological uptake and release of nutrients. (Humphreys-ISWS)
W80-06499

GEORGETOWN HARBOR, SOUTH CAROLINA; REPORT 2, EFFECTS OF VARIOUS CHANNEL SCHEMES ON TIDES, CURRENTS, AND SHOALING; HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
M. J. Trawle, and R. A. Boland, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A052 340, Price codes: A09 in paper copy, A01 in microfiche. Miscellaneous Paper H-78-6, May 1979. 126 p, 29 Tab, 39 Pl.

Descriptors: *Model studies, *Dredging, *Harbors, Effects, Salinity, Tidal effects, *Channels, Currents(Water), Hydraulic models, Navigation, Coastal engineering, *Shoaling, *Georgetown Harbor(SC).

The Georgetown Harbor model, a fixed-bed model constructed to linear scale ratios of 1:800 horizontally and 1:80 vertically, reproduced a portion of the Atlantic Ocean, Winyah Bay including Mud Bay, North Inlet and marshes between Winyah Bay and North Inlet, the Sampit River including Georgetown Harbor, and the lower portions of the Pee Dee, Black, and Waccamaw Rivers and adjacent marshes. The model was equipped with necessary appurtenances for the accurate reproduction and measurement of tides, tidal currents, salinity intrusion, freshwater inflow, and shoaling distribution. Purposes of the model study were (a) to determine the effects on the hydraulic, salinity, and shoaling characteristics of a deepening from 27 to 35 ft of the main navigation channel to Georgetown Harbor and (b) to determine whether present maintenance dredging can be reduced by proposed plans involving channel revision, sediment traps, and freshwater flow diversion. This report presents and analyzes the results of the testing of the following schemes: Western Channel and Turning Basin scheme, Marsh Island Channel and Turning Basin scheme, Upper Winyah Bay Side Channel Trap scheme, Inflow Diversion scheme, and Deepened Channel scheme. (WES)
W80-06539

MAYPORT-MILL COVE MODEL STUDY; REPORT 1, HYDRAULIC, SALINITY, AND SHOALING VERIFICATION; HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
N. J. Brogdon, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A073601, Price codes: A11 in paper copy, A01 in microfiche. Technical Report HL-79-12, July 1979. 222 p, 177 Pl, 1 Tab.

Descriptors: *Salinity, *Tides, *Model studies, Channels, Navigation, Coastal engineering, *Shoaling, Florida, *Mayport-Mill Cove(FL).

A fixed-bed model of Mayport-Mill Cove, constructed to scales of 1:500 horizontally and 1:50 vertically, reporoduced a portion of the Atlantic Ocean adjacent to the entrance and the St. Johns River upstream to Hibernia Point. The effects of proposed improvement plans for the Mayport Naval Basin area on existing shoaling rates, hydraulics, salinities, and flushing and the effects of proposed improvement plans in the Mill Cove area on flushing, hydraulics, salinities, and channel

shoaling were investigated. Phase 1 of the study involved the model verification tests, phase 2 involved the Mayport Naval Basin Study, and phase 3 involved the Mill Cove study. Phase 1 is reported herein; phases 2 and 3 will be reported in Reports 2 and 3 of this series. Model verification tests indicated the model hydraulic and salinity regimes were in satisfactory agreement with the prototype for comparable conditions. Model verification also included a comprehensive shoaling verification of shoaling rates and patterns in the navigation channel and Mayport Naval Basin. During the shoaling verification, model operation procedures were developed by trial and error to achieve satisfactory reproduction of observed prototype shoaling distribution patterns within the various reaches of the navigation channel and in Mayport Basin. (WES)
W80-06543

A NUMERICAL MODEL FOR TSUNAMI INUNDATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
J. R. Houston, and H. L. Butler.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A065090, Price codes: A03 in paper copy, A01 in microfiche. Technical Report HL-79-2, February 1979. 56 p, 21 Fig, 35 Ref, 1 Append.

Descriptors: *Tsunamis, *Floods, *Mathematical models, Waves(Water), Saline water intusion, Long waves, *Land inundation.

A two-dimensional and time-dependent numerical model was developed that calculates the land inundation of a tsunami. The model solves long wave equations that include bottom friction terms. A coordinate transformation was used to allow the model to employ a smoothly varying grid that allows cells to be small in the inundation region and large in the ocean. The model was verified by simulating the 1964 Alaskan tsunami at Crescent City, California. An application of the model to calculate inundation in a region of Hawaii is presented. (WES)
W80-06544

SHOALING IN HARBOR ENTRANCES; HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
B. K. Melton, and J. J. Franco.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A068213, Price codes: A04 in paper copy, A01 in microfiche. Technical Report HL-79-5, March 1979. 66 p, 29 Pl.

Descriptors: *Harbors, *Shoals, *Hydraulic models, Navigation, Channels, Channel morphology, Currents(Water), Effects, *Shoaling.

Presents results of a general investigation to determine and demonstrate some of the principles involved in shoaling in harbor entrances and some of the factors to be considered in the development of solutions to the problems. The model used was not a reproduction of a reach of any stream but was designed to fit in an existing facility and provide for two bends and straight reach between the bends. The model was of the movable-bed type with scales established arbitrarily as 1:400 horizontally and 1:100 vertically. Tests were conducted with the harbor entrance located along the concave bank of the upper bend, in the straight reach, and along the convex bank of the lower bend simultaneously. Results indicate: 1. There is a natural tendency for shoaling in entrances to harbors involving openings in bank lines of alluvial streams because of the sudden expansion in channel width and the lowering of the water level causing sediment-laden bottom currents to move toward the opening. 2. The tendency for shoaling in harbor entrances varies with the size of opening in the bank line, the location of the entrance with respect to the channel alignment, and flow conditions. (WES)
W80-06545

NUMERICAL ANALYSIS OF TIDAL CIRCULATION FOR LONG BEACH OUTER HARBOR PROPOSED LANDFILL,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
D. G. Outlaw, and D. C. Raney.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A069796, Price codes: A05 in paper copy, A01 in microfiche. Miscellaneous Paper HL-79-5, May 1979. 93 p, 2 Tab, 52 Pl, 9 Ref, 2 Append.

Descriptors: *Harbors, *Landfills, *Numerical analysis, Baseline studies, Tidal waters, Water circulation, Model studies, Proposed landfill, Harbor oscillations, *Tidal circulation, *Long Beach Harbor(CA).

A study was conducted for Long Beach Harbor to numerically investigate tidal circulation in existing basins and to define and evaluate the impact of a proposed oil terminal adjacent to pier J on existing harbor circulation. A two-dimensional depth-averaged formulation of the hydrodynamic equations was used in the model and an implicit-explicit finite difference scheme was used to numerically solve the equations. The numerical model had been verified in a previous study using tide and velocity data from the prototype and from physical model tests conducted at WES. Two landfill configurations for the oil terminal along with a channel dredging project in the Port of Los Angeles were considered in the study. Tidal currents were relatively unaffected by the proposed plans except near the oil terminal and the dredging project. Net discharges through the harbor entrances and through Cerritos Channel in the inner harbor were not changed significantly. (WES)
W80-06549

SIMULATION OF SALT-WATER INTERFACE MOTION,
GeoTrans, Inc., Reston, VA.
J. W. Mercer, S. P. Larson, and C. R. Faust.
Ground Water, Vol 18, No 4, p 374-385, July-August 1980. 14 Fig, 3 Tab, 12 Ref.

Descriptors: *Saline water-freshwater interfaces, *Coasts, *Groundwater, *Model studies, Mathematical models, Interfaces, Saline water, Freshwater, Saline water intrusion, Aquifers, Wells, Water wells, Equations, Analytical techniques.

A numerical model was presented that solved the partial differential equations describing the motion of salt water and fresh water separated by a sharp interface. The areal equations were based on the Dupuit approximation and were obtained from partial integration over the vertical dimension. Finite-difference techniques were applied and the utility of several solution schemes was tested. The most efficient and accurate solution scheme used block line-successive over-relaxation. Examples were given to test the model, to evaluate the Dupuit approximation, and to demonstrate the application to a field situation. The results showed that the model is in good agreement with an analytical solution, but under severe conditions the Dupuit approximation may be inappropriate. The model was applied to a field area near Kahului, Maui, Hawaii and results extend the analysis of the problem beyond previous efforts. (Sims-ISWS)
W80-06603

A STUDY OF SUBMERGED BREAKWATERS,
Singapore Univ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W80-06606

VARIABILITY OF PARTICULATE MATTER IN A SMALL COASTAL INLET,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.
K. Kranck.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 8, p 1209-1215, August 1980. 9 Fig, 37 Ref.

Descriptors: *Inlets(Waterways), *Organic matter, *Tidal effects, *Canada, Bays, Suspended solids, Particle size, On-site investigations, Water quality, Nitrogen, Carbon, Data collections, Aquatic environment, Plankton, Tides, *Nova Scotia, *Petpeswick Inlet (Nova Scotia).

Total suspended particulate matter concentration and grain size spectra, total and living particulate carbon, and dissolved nitrogen and carbon were measured at stations along the length of Petpeswick Inlet and over several tidal cycles. Distinct particle populations are associated with the water at the head and at the mouth of the inlet. Mixing of water masses and temporal periodicities cause variance in particle concentration and spectral shape which correspond to seasonal, tidal, and seiche variations. To explain the last, a process of transformation of organic matter between dissolved and particulate states by aggregate formation and breakup in response to turbulent changes was proposed. This model explains the short-term variability but requires verification with closer sampling interval and rigid statistical treatment of data. Irrespective of the cause, it is probable that small-scale variability of suspended particulate matter associated with turbulence fluctuations occurs in all embayments. If this is so, then any periodic sampling may be subject to aliasing unless very careful checks are made to eliminate this possibility. (Humphreys-ISWS)
W80-06610

OBSERVATION OF WAVELIKE MOTION OF THE GASPE CURRENT,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
C. L. Tang.
Journal of Physical Oceanography, Vol 10, No 6, p 853-860, June 1980. 11 Fig, 9 Ref.

Descriptors: *St. Lawrence Seaway, *Currents(Water), *Gulfs, *Canada, On-site investigations, Coasts, Data collections, Remote sensing, Measurement, Current meters, Water temperature, Salinity, *Gaspe Current(Nova Scotia).

From current meter and satellite data, an unusual pattern of movement of the Gaspe Current was identified on two occasions in the summer of 1978. On the first occasion, the axis of the current moved offshore and the deep current reversed its normal seaward direction. In the satellite pictures, a wavelike structure of the Gaspe Current began to appear when the current was moving toward its normal nearshore position after a several-day excursion offshore. In a few days, it developed into a form resembling an overgrown wave, which eventually broke. The time span for the event is about 10 days. During the second episode, the appearance of a wavelike structure was also preceded by a shift in the position of the Gaspe Current, but the changes in the current direction and temperature were much less drastic than in the first event. Results of calculations based on Niiler and Mysak's model of barotropic instability for a coastal jet suggest that the wavelike motion may be triggered by the increased instability of the Gaspe Current when it is away from the coast, since the effect of the coast is stabilizing. The model predicts an e-folding time of 1 day, a wavelength of 52 km and a period of 4 days, which compare favorably with the observed wavelength of 60 km and period of 3-5 days. (Humphreys-ISWS)
W80-06619

BENTHIC BOUNDARY-LAYER VELOCITY PROFILES: DEPENDENCE ON AVERAGING PERIOD,
Argonne National Lab., IL. Radiological and Environmental Research Div.
B. M. Lesht.
Journal of Physical Oceanography, Vol 10, No 6, p 985-991, June 1980. 4 Fig, 5 Tab, 12 Ref. COM/NOAA 03-3-022-111.

Descriptors: *Boundary layers, *Benthos, *Boundary processes, *New York, *Continental shelf, Turbulent boundary layers, Sediment-water interfaces, Velocity, Flow, Currents(Water), Profiles, On-site tests, Data collections, Analysis, Analytical techniques, Statistical methods, Sediment transport, Flow characteristics, *New York Bight, Velocity profiles.

The relationship between benthic boundary-layer velocity profiles and current meter averaging time was investigated using detailed (0.61 Hz) current measurements recorded within 1 m of the bottom on the inner continental shelf in the New York Bight. The percentage of velocity profiles which corresponds to the von Karman-Prandtl model of the neutrally stratified turbulent boundary layer increases rapidly as the averaging period is lengthened from a few seconds. When the averaging period exceeds approximately 20 times the characteristic time scale of the flow, the percentage of logarithmic profiles becomes independent of averaging period. This relationship was found for both wave and turbulence dominated flows. Increasing the averaging period beyond the minimum required to define stable mean values does not significantly change either estimates of mean friction velocity or the statistical distribution of the drag coefficient C sub 100 computed from the observations. (Humphreys-ISWS)
W80-06621

SOME OBSERVATIONS ON THE LIPID CONCENTRATION IN THE EMS-DOLLART ESTUARY AND THE WESTERN WADDEN SEA,
Nederlands Inst. voor Onderzoek der Zee, Texel. Biological Research Ems-Dollart Estuary.
R. W. P. M. Laane.
Estuarine and Coastal Marine Science, Vol 10, No 6, p 589-596, June 1980. 7 Fig, 6 Tab, 20 Ref.

Descriptors: *Estuaries, *Lipids, *Organic matter, Sampling, Chemical analysis, Analytical techniques, Biomass, Dissolved solids, Suspended solids, Carbon, Zooplankton, Chlorophyll, Metabolism, Coasts, *Ems-Dollart Estuary(The Netherlands), *Wadden Sea(The Netherlands).

The chloroform-methanol extractable compounds (lipids) of organic matter in seawater were measured from February to December 1978 in the Ems-Dollart estuary. The concentration of total lipids (dissolved and particulate) ranged from 0.012 to 0.7 mg carbon/l (0.2-15.2% of total organic carbon). In March 1979 the dissolved lipid concentration in the Ems-Dollart esturary was measured: of the total lipids 63.4-83.8% were dissolved, hence 16.2-36.6% of the lipids are in particulate material. In June and October 1978, two surveys were made in the western part of the Wadden Sea to compare the total lipid concentrations there with the results in the Ems-Dollart. Total lipid concentration in this part of the Western Wadden Sea ranged from 0.018 to 0.154 mg carbon/l (1-4.5% of total organic carbon). The contributions of the 'living' and the 'detrigeneous' parts in the total lipid content were discussed. (Sims-ISWS)
W80-06651

THERMOCLINE FORMATION IN THE CELTIC SEA,
Institute of Oceanographic Sciences, Birkenhead (England).
I. D. James.
Estuarine and Coastal Marine Science, Vol 10, No 6, p 597-607, June 1980. 11 Fig, 2 Tab, 9 Ref.

Descriptors: *Thermocline, *Stratification, *Coasts, *Oceans, Sampling, Surveys, Data processing, Thermal stratification, Heat budget, Heat, Temperature, Mixing, Winds, Tides, Tidal effects, *Celtic Sea.

Thermistor chain records made in the Celtic Sea during April and May 1978 show the onset of the seasonal thermocline. This occurs in a matter of days as a result of a series of heating and mixing events. These events were explained in the light of estimates of heat fluxes and of the effectiveness of wind and tidal mixing as measured by a Monin-Obukhov length scale. (Sims-ISWS)
W80-06652

SEDIMENTATION IN THE FRASER RIVER AND ITS ESTUARY, SOUTHWESTERN BRITISH COLUMBIA (CANADA),
Geological Survey of Canada, Vancouver (British Columbia).
For primary bibliographic entry see Field 2J.
W80-06653

THE FATE OF TRACE METALS IN NARRAGANSETT BAY, RHODE ISLAND: RADIOTRACER EXPERIMENTS IN MICROCOSMS,
Lamont-Doherty Geological Observatory, Palisades, NY.
P. H. Santschi, Y. H. Li, and S. R. Carson.
Estuarine and Coastal Marine Science, Vol 10, No 6, p 635-654, June 1980. 7 Fig, 6 Tab, 39 Ref. EPA R803902-02.

Descriptors: *Trace elements, *Metals, *Bays, *Laboratory tests, Model studies, Mathematical models, Tracers, Radioisotopes, Chemicals, Sediments, Marine biology, Estuaries, Pollutants, Path of pollutants, Water pollution, *Narragansett Bay(RI).

Experiments designed to determine removal rate constants and removal mechanisms of various radioactive trace metals (51Cr, 54Mn, 58Co, 59Fe, 65Zn, 75Se, 115mCd, 134Cs, 210Po, 210Pb, 226Ra, 228Th) in controlled ecosystems simulating Narragansett Bay conditions in spring and early summer seasons were described. Overall removal could adequately be described with a model assuming first order removal to several reservoirs. Initial removal rates in two identical tanks replicated well during the early summer experiment. The removal behavior of Mn, Cr, and Se changed after the first 1-2 weeks of the same experiment. Although adsorption to walls and other tank parts was significant, that fraction seemed to be effectively removed from further interaction and would be accounted for in the model. The major mechanisms for metal uptake that would be characteristic of the natural system were found to be scavenging by particles that settled from the water column (mostly resuspended sediment) and direct adsorption within the bioturbated layer of sediment. Generally slower removal was observed during the early summer relative to the spring and was ascribed to a combination of trace metal association with low molecular weight organic compounds and increasing rates of return from the sediments. Bioturbation rates in the top 3 cm of the sediments in the spring experiments were similar to other experimental values for Narragansett Bay and other coastal regions: a mixing coefficient of 2-5 x 10 to the minus 7 power sq cm/s was calculated. (Sims-ISWS)
W80-05654

TIDAL FLUCTUATIONS IN BIOLOGICAL OXYGEN DEMAND IN EXPOSED SANDY BEACHES,
Port Elizabeth Univ. (South Africa). Dept. of Zoology.
A. H. Dye.
Estuarine and Coastal Marine Science, Vol 11, No 1, p 1-8, July 1980. 4 Fig, 30 Ref.

Descriptors: *Biochemical oxygen demand, *Variability, *Beaches, *Tidal effects, Tides, Wetting, Drying, Moisture content, Oxygen, Benthic fauna, Sampling, On-site investigations, Data processing, Analytical techniques, Fluctuations, Biology, *South Africa, South Africa coast.

Tide-induced fluctuations in biological oxygen demand (BOD) on two medium to fine sandy beaches were recorded over two separate 24-hr periods in February (summer) 1979. Fluctuations in BOD of over two orders of magnitude were found with the highest occurring at or just after high tide and the lowest at low tide. Greatest fluctuations occurred at the higher tidal levels as well as near the surface of the substratum. Significant correlations between BOD and the degree of water saturation of the sand were found, although no such correlations with either bacterial or protozoan numbers or temperature occurred. It appears that in areas of the beach where the water content decreases to 30% or less, BOD is greatly reduced and increases again only upon re-wetting by the incoming tide. Measurements of BOD made during low tide in such areas may underestimate oxygen consumption by as much as 300%. Conversely, measurements made on saturated sediments only may be overestimates of a similar magnitude. (Sims-ISWS)
W80-06656

TIDAL RESUSPENSION IN BUZZARDS BAY, MASSACHUSETTS, III. SEASONAL CYCLES OF NITROGEN AND CARBON: NITROGEN RATIOS IN THE SESTON AND ZOOPLANKTON,
Miami Univ., FL. Rosenstiel School of Marine and Atmospheric Science.
M. R. Roman.
Estuarine and Coastal Marine Science, Vol 11, No 1, p 9-16, July 1980. 5 Fig, 1 Tab, 39 Ref. NSF DES75-10025, GA-39911.

Descriptors: *Nitrogen, *Carbon, *Seasonal, *Tidal waters, *Massachusetts, Sampling, On-site investigations, Data processing, Methodology, Seston, Zooplankton, Nutrients, Biomass, Phytoplankton, Bays, Estuaries, Tidal effects, *Buzzards Bay(MA).

Seasonal changes in zooplankton nitrogen biomass, particulate organic nitrogen, and dissolved inorganic nitrogen species were measured for 2 years at a station in Buzzards Bay, MA. The ratio of particulate organic N : dissolved inorganic N : zooplankton N ranged from 64 : 32 : 1 to 5 : 2 : 1. The C : N ratio (by weight) of zooplankton was relatively constant over the 2 years, ranging from 3.6 to 4.7, whereas the C : N ratio of seston (by weight) fluctuated from a minimum of 5.1 in summer to a maximum of 13.6 in winter. The percentages of C and N of the zooplankton average 38% and 10%, respectively, but decreased to below 5% C and 1% N in August, September, and October when the ctenophore Mnemiopsis leidyi was abundant in the bay. Zooplankton daily ration was estimated as 25 and 75% of their nitrogen biomass and compared to approximate N assimilation by phytoplankton as well as the total particulate nitrogen pool. Over most of the year in Buzzards Bay the approximate daily N assimilated by phytoplankton was lower than estimated zooplankton daily ration, suggesting that detritus is the dominant particulate nitrogen pool consumed. (Sims-ISWS)
W80-06657

ON THE STOKES' DRIFT INDUCED BY TIDAL MOTIONS IN A WIDE ESTUARY,
Heriot-Watt Univ., Edinburgh (Scotland). Dept. of Offshore Engineering.
P. P. G. Dyke.
Estuarine and Coastal Marine Science, Vol 11, No 1, p 17-25, July 1980. 2 Fig, 19 Ref.

Descriptors: *Drifting(Aquatic), *Tidal waters, *Estuaries, *Mass transfer, *Model studies, Mathematical models, Analytical techniques, Numerical analysis, Waves(Water), Tides, Tidal effects, Stratification, Circulation, Water circulation, Coriolis force, Oceanography, *Stokes' drift.

This paper presents a simple analytical model of tidal motion in a wide estuary. The essential feature of the model is its ability to include both the Coriolis acceleration and, to a limited extent, vertical stratification of density. It was shown that the Coriolis acceleration is not important when considering the depth integrated or barotropic flow, but is important when considering baroclinic motions. Further, arguments show that the Stokes' drift is a fair representation of tidally induced residual flow, and that barotropic Stokes' drift on the kind of length scales appropriate to an estuary are dominated by friction. However, when considering depth dependent flow (the baroclinic mode), an inviscid Stokes' drift is present having a typical magnitude of 2 cm/s. The flow pattern for this drift in a straight sided estuary shows an equal and opposite flow along each bank, with the flow itself exhibiting a periodic structure (i.e., reversals) at well defined intervals down the estuary. The Stokes' drift along the axis of symmetry of the estuary is zero. Applications of this model to real estuaries is discussed. (Sims-ISWS)
W80-06658

MODELLING OF TIDAL BARRIER SCHEMES: AN ANALYSIS OF THE OPEN-BOUNDARY

PROBLEM BY REFERENCE TO AC CIRCUIT THEORY,
Institute of Oceanographic Sciences, Birkenhead (England).
D. Prandle.
Estuarine and Coastal Marine Science, Vol 11, No 1, p 53-71, July 1980. 13 Fig, 1 Tab, 15 Ref.

Descriptors: *Estuaries, *Barriers, *Tides, :Model studies, Mathematical models, Numerical analysis, Theoretical analysis, Analytical techniques, Hydrodynamics, Tidal energy, Tidal streams, Tidal waters, *England, Tidal barriers, *Thames estuary, Bristol Channel, Boundary effects.

In modeling a tidal barrier scheme it is generally difficult to determine whether the downstream boundary is sufficiently seaward to ensure that the prescribed boundary conditions, pertaining to the existing system, remain valid after the barrier has been installed. This problem was examined using the hydrodynamic analogy with AC circuit theory; the essential elements of this theory were summarized. The first application of this theory concerned the effect of tidal barriers in the River Thames; it was shown that barriers in the region between North Woolwich and Chelsea Bridge will lead to a small increase in the M sub 2 tidal range. Using a number of models with the downstream boundary successively further downstream, the different results were analyzed in a manner which provides an indication of the validity of the tidal prognostication for any particular boundary location. The second application concerned the Bristol Channel where it was shown that barriers downstream of Newport will produce a small reduction in the M sub 2 tidal range. In view of the present interest in this region this is an important result confirming the earlier findings of Heaps. (Sims-ISWS)
W80-06659

SUMMERTIME ADVECTION OF LOW SALINITY SURFACE WATERS INTO ONSLOW BAY,
Skidaway Inst. of Oceanography, Savannah, GA.
J. J. Singer, L. P. Atkinson, and L. J. Pietrafesa.
Estuarine and Coastal Marine Science, Vol 11, No 1, p 73-82, July 1980. 7 Fig, 3 Tab, 15 Ref. DOE EY-76-S-09-0889, EY-76-S-09-0902, Dept. of Commerce 04-6-158-44054.

Descriptors: *Currents(Water), *Ocean currents, *Coasts, *Atlantic Ocean, *North Carolina, Continental shelf, Salinity, Advection, Winds, Sampling, Surveys, On-site investigations, Data processing, Distribution patterns, Freshwater, Oceans, Oceanography, North Carolina coast, *Onslow Bay(NC), Freshwater inflow.

Low salinity plumes have been observed to emanate from the southwestern corner of Onslow Bay, North Carolina, near Cape Fear and to extend northeasterly towards Cape Lookout. The length of these plumes is 100-120 km, roughly two-thirds the southwest to northeast extent of the bay. They influence as much as 20% of the surface area of the bay with freshwater volumes ranging from 0.69 to 0.86 cu km. This corresponds to at least 15% of the freshwater volume of the entire bay. The freshwater flux as the plumes croos Frying Pan Shoals ranges from 225 to 405 cu m/s. These plumes dominated the surface salinity structure over the inner half of the shelf in Onslow Bay during 14-15 July and 21-23 July 1976. In addition, a southwesterly flow of waters from Raleigh Bay into Onslow Bay was also observed during the same period. Both flows appear to result from wind-induced circulation. (Sims-ISWS)
W80-06660

EVIDENCE FOR THE FORMATION AND AGE OF A COMMERCIAL SAND DEPOSIT IN THE BRISTOL CHANNEL,
University of Wales Inst. of Science and Technology, Cardiff.
C. M. Davies.
Estuarine and Coastal Marine Science, Vol 11, No 1, p 83-99, July 1980. 14 Fig, 2 Tab, 20 Ref.

Descriptors: *Sands, *Estuaries, *Dredging, Sediments, Sediment transport, Aggregates, Gravels, Bedrock, Bed load, Suspended solids, Tidal waters, Tidal effects, On-site investigations, Sampling, Sonar, Oceanography, *Bristol Channel(UK).

Periodic surveys have been made of Holm Sand, a Holocene deposit incorporating One Fathom Bank and part of Mackenzie Shoal in the Bristol Channel. The deposit is worked for sea-dredged aggregate, primarily building and concreting sands, although the latter are becoming depleted. The surveys showed that the deposit lies on irregular pre-Holocene substrate and is incorporated as two suites of sand waves: large, mainly asymmetrical, outer sand waves and smaller, symmetrically variable, inner sand waves. Sediments were classified into seven types (A-G), outer sand waves being formed in gravelly sands and sandy gravels (types C-F) and inner sand waves in unimodal medium sands (types A and B). It was suggested that sand wave scale is related to transport mode: transport of inner waveform sediments is mainly as suspended load, whereas outer waveform sediments are transported part as bed load, part as suspended load. A progressive sequence of profiles was evident in outer sand waves, and their alignment and mobility indicate that Holm Sand sediments are derived from channels to the northwest and southeast. This sequence, together with a progressive fining in mean sizes towards the deposit axis, suggests that the structure could have evolved during the (Holocene) Sub-Atlantic period. (Sims-ISWS)
W80-06661

UTILIZATION OF TIDAL CURRENTS BY ESTUARINE ZOOPLANKTON,
Port Elizabeth Univ. (South Africa). Dept. of Zoology.
T. Wooldridge, and T. Erasmus.
Estuarine and Coastal Marine Science, Vol 11, No 1, p 107-114, July 1980. 6 Tab, 16 Ref.

Descriptors: *Zooplankton, *Estuaries, *Spatial distribution, *Tidal effects, Distribution patterns, Plankton, Currents(Water), Tides, Tidal bores, Tidal waters, Coasts, On-site investigations, Sampling, Surveys, Salinity, Temperature, Water temperature, Flow, Marine biology, *South Africa.

Strong tidal currents in the Sundays river estuary, South Africa, prompted an investigation into the possibility of endemic populations avoiding or utilizing currents in a vertical and lateral plane as a mechanism of maintaining themselves within the estuary. The copepod, Pseudodiaptomus hessei, avoided inflowing and outflowing surface currents but migrated towards the surface at slack water. Acartia longipatella and A. natalensis remained in greater numbers near the bottom on the ebb tide, moving laterally into areas of slowest current velocity. Spatial distribution patterns of the two species of Acartia were maintained by different behavioral responses on the flood tide. A. longipatella was present in slower currents while A. natalensis was present in greater numbers in faster flowing currents and so moved higher up the estuary than A. longipatella. The large mysid Rhopalophthalamus terranatalis was always present in greater numbers near the bottom, maintaining position through lateral migration, avoiding faster flowing currents on the ebb, but utilizing these faster currents on the flood tide to move up the estuary. Adults of the mysid, Mesopodopsis slabberi, utilized both vertical and lateral migration as a means of maintaining position in the estuary. (Sims-ISWS)
W80-06662

SEA-RUN RAINBOW TROUT OF THE EERSTE RIVER,
For primary bibliographic entry see Field 8I.
W80-06719

ESTUARINE SEDIMENTS: SUCCESSIONAL MODEL,
Oregon State Univ., Corvallis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W80-06757

A TIDAL-POWERED WATER SAMPLER,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
For primary bibliographic entry see Field 7B.
W80-06766

TURBULENCE MEASUREMENTS IN SIMULATED TIDAL FLOW,
Hydraulics Research Station, Wallingford (England).
For primary bibliographic entry see Field 8B.
W80-06817

DENSE BOTTOM CURRENTS IN ROTATING OCEAN,
Technical Univ. of Denmark, Lyngby. Inst. of Hydrodynamics and Hydraulic Engineering.
F. Bo Pedersen.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY8, Proceedings Paper 15629, p 1291-1308, August 1980. 8 Fig, 3 Tab, 12 Ref, 2 Append.

Descriptors: *Density currents, *Oceans, *Ocean currents, *Model studies, Mathematical models, Flow, Friction, Entrainment, Froude number, Ocean circulation, Currents(Water), Oceanography, *Denmark Strait, Ocean engineering, Rotation.

The dynamic equations for a steady dense bottom current on a gently sloping plane in a rotating ocean were outlined. The entrainment and the friction at the wall and the interface respectively were parameterized by making use of the findings for nonrotating dense bottom currents which were summarized. By introducing an appropriate nondimensional length scale, the equations were solved to yield the discharge, velocity, density, depth, width, densimetric Froude number, etc., along the predicted curved path line of the current. The usefulness of the model was demonstrated by applying it to the Denmark Strait Overflow. (Sims-ISWS)
W80-06818

IMPROVED STABILITY OF DRONKERS' TIDAL SCHEMES,
Waterloopkundig Lab., Delft (Netherlands). Mathematics Branch.
G. S. Stelling.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY8, Proceedings Paper 15660, p 1365-1379, August 1980. 2 Fig, 7 Ref, 2 Append.

Descriptors: *Tides, *Tidal streams, *Currents(Water), *Model studies, Mathematical models, Theoretical analysis, Analytical techniques, Stability, Tidal effects, Coasts, Rivers, Estuaries, Channels, Mathematics, Equations, Finite difference theory.

Stability conditions of Dronkers' explicit finite difference schemes for tidal computations in rivers and open channels were derived. In addition to the CFL condition, more stringent stability conditions were found. Changing the approximation of the nonlinear terms by applying the 'Angled Derivative' method resulted in a second-order finite difference scheme of the same computational efficiency as a purely explicit scheme for which the only stability condition is the CFL condition. (Sims-ISWS)
W80-06823

SAND MOTION INITIATION BY WATER WAVES: TWO ASYMPTOTES,
Coastal Engineering Research Center, Fort Belvoir, VA.
For primary bibliographic entry see Field 2J.
W80-06829

WATER LEVEL VARIATIONS ALONG CALIFORNIA COAST,
National Ocean Survey, Rockville, MD.
R. A. Smith, and R. J. Leffler.
Journal of the Waterway, Port, Coastal and Ocean Division, American Society of Civil Engineers,

Vol 106, No WW3, Proceedings Paper 15614, p 335-348, August 1980. 13 Fig, 1 Tab, 12 Ref, 2 Append.

Descriptors: Water levels, *Coasts, *Water level fluctuations, *California, Data processing, Statistical methods, Curves, *Tides, Storms, Sea level, Seasonal, Variability, Meteorology, Lunar effects, Coastal processes.

Daily, monthly, yearly, and long-term variations in sea level relative to land, and highest water levels were examined at 15 locations along the California coast. The longest, uninterrupted set of tidal measurements (1854-1978) in the United States are at the Golden Gate. Such a series is invaluable in long-term sea level variation studies and storm frequency analysis. Maximum expected heights with time for the Golden Gate were computed and graphed. Graphs displaying the highest water level each month for the period 1933 through 1977 for four widely distributed long-term stations in California indicated the frequency of occurrence and maximum vertical heights. (Sims-ISWS)
W80-06831

A RAPID IN SITU METHOD OF EXTRACTING WATER FROM TIDAL MARSH SOILS,
Gulf Coast Research Lab., Ocean Springs, MS. Botany Section.
For primary bibliographic entry see Field 2G.
W80-06842

VERTICAL STRUCTURE OF TIME-DEPENDENT FLOW DOMINATED BY FRICTION IN A WELL-MIXED FLUID,
Minnesota Univ., Duluth. Dept. of Physics.
T. F. Jordan, and J. R. Baker.
Journal of Physical Oceanography, Vol 10, No 7, p 1091-1103, July 1980. 10 Fig, 3 Tab, 19 Ref. EPA R805667-01-0.

Descriptors: *Hydrodynamics, *Flow, *Fluid friction, *Model studies, Mathematical models, Equations, Mathematics, Theoretical analysis, Oceans, Lakes, Viscosity, Mixing, Currents(Water), Oceanography, Estuaries, Well-mixed fluids, Flow vertical structure.

Solutions of a linear hydrodynamic equation of motion with linear boundary conditions were obtained to describe the horizontal current, as a function of depth and time, determined by a given history of the wind force and pressure gradient up to that time, at a fixed point in the horizontal plane, in well-mixed water of finite depth. The bottom friction was assumed to be proportional to the bottom current, with zero bottom current and zero bottom friction considered as limiting cases. The general solution was established as an eigenfunction expansion when the eddy viscosity is given as a positive function of depth. Explicit formulas were worked out for viscosity functions that are constant, exponential, or varying as a power of the height from somewhere below the bottom or above the top of the water. For the latter the limit as the viscosity goes to zero at the bottom or top was considered. Numerical results were presented for viscosities that are constant, exponential, linear, or varying as the 3/4 power. (Sims-ISWS)
W80-06843

SENSOR RESPONSE MISMATCHES AND LAG CORRECTION TECHNIQUES FOR TEMPERATURE-SALINITY PROFILERS,
Woods Hole Oceanographic Inst., MA.
E. P. W. Horne, and J. M. Toole.
Journal of Physical Oceanography, Vol 10, No 7, p 1122-1130, July 1980. 6 Fig, 1 Tab, 18 Ref, 1 Append. NSF OCE77-28355.

Descriptors: On-site investigations, *Instrumentation, Data processing, *Oceans, *Temperature, Water temperature, *Salinity, Pressure, Depth, Analytical techniques, Oceanography, Error analysis, Correction techniques, *Sensor response.

Salinity-temperature-depth profilers measure temperature directly but infer salinity from measurements of temperature, pressure, and conductivity. Errors may therefore be introduced into the salinity data because of dissimilar response characteristics of the various sensors. This response mismatch usually manifests itself as the temperature signal lagging the conductivity signal in time. An error analysis demonstrated that amplitude underestimations of only 1% with a phase error of only 5 deg in the temperature data can result in a 20% overestimation of salinity variance. Techniques for removing the effects of sensor-response mismatches in the data were discussed, and a new method was presented. The method involves the determination of correction filters for the data in physical space in terms of the response function of the sensors which is in frequency space. Thermohaline features on vertical scales smaller than 1 m appear resolvable in CTD data that are corrected with this technique. (Sims-ISWS)
W80-06845

UPWELLING IN A NEARSHORE MARINE ECOSYSTEM AND ITS BIOLOGICAL IMPLICATIONS,
Cape Town Univ. (South Africa). Dept. of Zoology.
J. G. Field, C. L. Griffiths, E. A. Linley, R. A. Carter, and P. Zoutendyk.
Estuarine and Coastal Marine Science, Vol 11, No 2, p 133-150, August 1980. 12 Fig, 2 Tab, 17 Ref, 1 Append.

Descriptors: *Upwelling, *Coasts, *Ecosystems, *On-site investigations, Organic matter, Phytoplankton, Density, Bacteria, Nutrients, Currents(Water), Phosphorus, Silica, Nitrates, Kelps, Water temperature, Dissolved oxygen, Chlorophyll, Suspended solids, On-site data collections, *South Africa, Particulate matter.

The flow of water into and out of a kelp-bed on the west coast of southern Africa was monitored over a 24-day period, spanning three upwelling cycles. Currents, measured by scuba divers at five stations around the study site reached 40 cm/s at the surface, but were slower and more variable in mid-water (4-11 m) and just above the bottom (8-22 m). Surface currents correlated with wind, but not tide, offshore winds causing offshore surface drift and onshore currents below, while onshore winds reversed these flow patterns. Water transport budgets indicate that the volume of water at the study site (3,750,000 cu m) turned over between three and seven times per day during upwelling. Nutrients (N03, P, and Si) peaked during active upwelling, when temperatures fell below 12 C, and were minimal under downwelling conditions, N03 falling to 1 microgram/1. Phytoplankton density was lowest during upwelling and peaked during onshore winds. The concentration of suspended particulate organic matter varied between 0.7 and 5.5 mg/1 dry mass, the highest values occurring during heavy wave action. The number of suspended bacteria ranged from 70,000 to 3,620,000 cells/ml, with peaks lagging 1 day behind those of POM. Biological implications of these measurements were discussed. (Humphreys-ISWS)
W80-06847

SOME ASPECTS OF TIDAL INTERACTION WITH FJORD CONSTRICTIONS,
Goteborg Univ. (Sweden). Oceanographic Inst.
A. Stigebrandt.
Estuarine and Coastal Marine Science, Vol 11, No 2, p 151-166, August 1980. 7 Fig, 3 Tab, 18 Ref.

Descriptors: *Fjords, *Tidal waters, *Tidal effects, *Mathematical models, Tides, Internal waves, Theoretical analysis, Stratified flow, Mixing, Analytical techniques, Inlets(Waterways), Water levels, Fjord constrictions.

Tidal interaction with fjord constrictions was discussed. Two typical cases were thoroughly analyzed. The first was the so-called tidal choking problem where the effect of vertical stratification is insignificant. In the second case the influence of vertical stratification is crucial, and the forcing barotropic tide generates internal waves at the constriction (a sill in this case). Some theoretical gaps in the field of tidal interaction with fjord constrictions were filled. First a theory for tidal choking in a fjord with freshwater runoff was presented. A table was given which can be used for a quick determination of tidal choking effects in almost any fjord. Second, a simple theory for internal wave generation by tides in a linearly stratified fjord was developed. The predictions were compared with measurements from the Herdlafjord (from Fjeldstad) with encouraging results. The knowledge of the physics of the constriction is a prerequisite for a successful development of a physical model of a whole fjord with a constriction at the mouth. Moreover the specific flow generated by the tides at the constriction can in many instances be the dominating energy source for turbulence capable of vertical mixing in the fjord. The jet generated in the tidal choking regime can cause a lot of mixing in some fjords. Although the vertical stratification does not play any role in the theory for tidal choking, the resulting jet on the lee side must be considered as a buoyant (positively or negatively) jet when entering the fjord, and the final depth for the jet depends on, among other factors, its momentum and relative buoyancy. (See also W79-07335) (Humphreys-ISWS)
W80-06848

FINITE ELEMENTS IN WATER RESOURCES, VOLUME 1.
For primary bibliographic entry see Field 2A.
W80-06858

COLLOCATION FORMULATIONS FOR THE FINITE ELEMENT ANALYSIS OF TIDAL AND TRANSPORT PROCESSES IN ESTUARIES,
Hanover Univ. (Germany, F.R.). Inst. of Structural and Numerical Mechanics.
U. Meissner, and R. Ratke.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 2.167-2.176, 1980. 7 Fig, 2 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Estuaries, *Tidal waters, *Path of pollutants, *Model studies, Mathematical models, Finite element analysis, Tides, Flow, Rivers, Pollutants, Water pollution, Heated water, Coasts, Mathematics, Numerical analysis.

The simulation of the tidal motion and of the transport of pollutants in rivers and estuaries is of great importance for coastal and environment protection in practice. Many authors have developed numerical models that were successfully used in various applications. The finite element method supplies high flexibility for the modeling of complicated systems through its irregular mesh refinements and its coupling abilities of different elements. Although the method is theoretically well analyzed and proves to be reliable, there are still numerical problems left to be investigated as far as accuracy and computer costs are concerned. The techniques to solve the transport-diffusion-type equation need to be improved as numerical dispersion has a great influence on the accuracy of the solution. It was found that some improvements could be achieved by the use of the subdomain collocation method. This finite element formulation is straightforward, derived from the conservation principles of physics, and ends up in implicit as well as explicit numerical models which may be combined in a unique way. (See also W80-06858) (Sims-ISWS)
W80-06877

SEAWATER INTRUSION IN CONTINUOUS COASTAL AQUIFER-AQUITARD SYSTEMS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
E. O. Frind.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 2.177-2.198, 1980. 6 Fig, 17 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Saline water-freshwater interfaces, *Mathematical models, *Finite element analysis, *Coasts, Saline water intrusion, Aquitards, Aquifers, Porous media, Model studies, Analytical techniques, Equations, Leakage, Analysis.

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The idealized system considered consisted of a confined aquifer, which is the main water-bearing unit, a leaky aquitard, and a thin water-table aquifer. Both aquifer and aquitard are continuous and extend out under the sea. The governing equations are the Darcy equation, the continuity equation for the fluid, the continuity equation for the dissolved salt, and a constitutive equation relating fluid density to salt concentration. The simulations showed that the aquitard in a continuous aquifer-aquitard system exerts a controlling influence on the dynamics of the entire system. The influence of the aquitard also manifests itself in the magnitude of the leakage flux at the recharge boundary. The time scale required for the occurrence of changes in the salt distribution that would be significant on the spatial scale considered appeared to be at least in the order of decades, while the time period required for a transient response to dampen out may be in the order of centuries. By defining the static head of freshwater at the top of the confined aquifer, a Ghyben-Herzberg interface for the aquifer can be generated. In the absence of the aquitard, the Ghyben-Herzberg interface would be located at a higher elevation, and freshwater discharge would cease a short distance from the shore. The model was found to be capable of handling the long time periods over which transient responses may occur. (See also W80-06858) (Humphreys-ISWS)
W80-06878

BEHAVIOR OF SEAWATER INTRUSION IN LAYERED COASTAL AQUIFERS,
Kobe Univ. (Japan). Faculty of Engineering.
T. Kawatani.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 2.199-2.208, 1980. 5 Fig, 10 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Saline water intrusion, *Aquifers, *Saline water-freshwater interfaces, *Model studies, Mathematical models, Equations, Numerical analysis, Simulation analysis, Finite element analysis, Groundwater, Groundwater movement, Sea water, Freshwater, Coasts, Water resources, Coastal aquifers.

For the efficient usage of groundwater in coastal areas, it is important to know the behavior of the seawater intrusion in a coastal aquifer. There are two approaches to the problem of motion of the seawater wedge in porous medium. In one case, the freshwater and seawater are considered to be immiscible. A distinct interface separates these two liquids. The problems of the interface in coastal aquifers under various conditions were studied by many investigators. Collins and Gelher analyzed the multiple seawater wedges in a two-layered coastal aquifer. This type of approach, however, encounters difficulties when the aquifer system is complex and/or the change in the shape of intrusion is large. This is quite true in applying the finite element method to the problem of the interface. The coastal aquifer system is sometimes divided into several strata by interlying semipervious or impervious layers. The multiple seawater wedges develop therein. The position and shape of the interfaces are unknown a priori. As far as two liquids are assumed to be immiscible, the interface turns out to be a boundary along which a certain condition should be satisfied. In applying the finite element method, the position of the interfaces should be speculated in order to divide each liquid region into elements individually. This makes the application of the finite element method to the problem difficult. In another case, the seawater and freshwater are considered to be soluble in each other. No distinct interface exists. This type of flow is referred to as hydrodynamic dispersion. This approach eliminates the difficulty due to the inner boundary even if the aquifer system is complicated. In this study, the freshwater and seawater are considered to be miscible. The governing equations for the problem consist of the equation of groundwater flow and the transport equation which must be solved simultaneously. (See also W80-06858) (Sims-ISWS)
W80-06879

COASTAL SEAWATER INTRUSION: A MOVING BOUNDARY PROBLEM,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
A. A. G. Sa da Costa, and J. L. Wilson.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 2.209-2.218, 1980. 7 Fig, 9 Ref. Science and Education Administration, New Orleans, LA. NOAA 88127.

Descriptors: *Saline water intrusion, *Saline water-freshwater interfaces, *Model studies, Mathematical models, Finite element analysis, Equations, Numerical analysis, Simulation analysis, Groundwater, Groundwater movement, Aquifers, Coasts, Water resources, Coastal aquifers.

The growth of population in coastal areas has created an increasing demand for freshwater. Often this increase in demand is satisfied by a more intensive pumping of groundwater upsetting the long-term natural balance of freshwater flowing underground to the sea and the heavier underlying wedge of seawater. As a consequence, the seawater wedge advances inland, encroaching on the underground supply of freshwater and threatening its availability with contamination by brackish water. This paper presented a finite element model, SWIM, an acronym for Sea Water Intrusion Model, that simulated groundwater flow in coastal aquifers and under offshore islands. (See also W80-06858) (Sims-ISWS)
W80-06880

SIMULATION OF THE TRANSIENT POSITION OF THE SALTWATER INTRUSION IN THE COASTAL AQUIFER NEAR MADRAS COAST,
Technische Hochschule, Aachen (Germany, F.R.).
G. Rouve, and W. Stoessinger.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 2.219-2.228, 1980. 4 Fig, 6 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Saline water intrusion, *Saline water-freshwater interfaces, *Model studies, Mathematical models, Numerical analysis, Simulation analysis, Aquifers, Coasts, Physical properties, Geology, Hydrogeology, Groundwater, Groundwater movement, Water resources, Coastal aquifers.

The problem of seawater intrusion has assumed greater significance in South India which in recent years has come to depend more and more on groundwater resources. Thus there is a need to predict the formation and movement of a saltwater interface in the coastal aquifers near Madras in order to be able to protect the freshwater aquifers from the danger of contamination. The movement of a saltwater wedge into a coastal aquifer can be described as a density dependent mixing process in a granular porous medium. This is called hydrodynamic dispersion. Mathematical formulation of the hydrodynamic dispersion yields a set of nonlinear partial differential equations. Because of the complex nature of these equations, except for a few very simple cases, there exists no exact analytical solution. To solve the practical problems involving such equations, a numerical approach was adopted. In order to get a clear idea of the movement of the saltwater interface, a numerical model based on finite element discretization was developed and applied to a typical case of the aquifer at Madras. (See also W80-06858) (Sims-ISWS)
W80-06881

SOME CONSIDERATIONS IN FINITE ELEMENT SOLUTIONS TO COUPLED GROUNDWATER FLOW AND CONVECTIVE-DISPERSION EQUATIONS,
Clemson Univ., SC. Dept. of Civil Engineering.
S. C. Anand, A. Pandit, and B. L. Sill.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol.), Mississippi University, Oxford, May 19-23, 1980. p 3.97-3.107, 1980. 10 Fig, 8 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Saline water intrusion, *Mathematical studies, *Finite element analysis, *Groundwater movement, Convection, Dispersion, Analytical techniques, Analysis, Mathematical models, Saline water-freshwater interfaces, Aquifers, Coasts, Path of pollutants.

Solutions for the two-dimensional, steady-state saltwater encroachment problem were obtained by the finite element method for a realistic range of Peclet numbers and discharge parameters (field parameters), and the related problems were discussed in some detail. Since the difference in the field parameters of various aquifers is vast, an endeavor was made to determine a realistic range of values for the Peclet number and the discharge parameter a and to study their effect on saltwater encroachment. Several mesh sizes were tried using linear triangular elements, and it was found that the selection of a proper mesh size is extremely important for certain values of Peclet numbers and discharge parameters. It was found that solution instability could occur due to high velocities near the seawater face or due to the presence of sharp concentration gradients in a region away from it at high Peclet numbers. For certain values of Peclet numbers and discharge parameters, seawater intrudes far enough inland that an aquifer length of twice its depth cannot be considered adequate for a boundary condition of concentration = 0 to be imposed on the side farthest away from the seawater face. Several lengths of aquifers using appropriate finite element meshes were used to illustrate this effect. (See also W80-06858) (Humphreys-ISWS)
W80-06893

FINITE ELEMENTS IN WATER RESOURCES, VOLUME 2,
For primary bibliographic entry see Field 2A.
W80-06894

FINITE ELEMENT METHODS IN TWO LAYER AND MULTI-LEVELED FLOW ANALYSIS,
Chuo Univ., Tokyo (Japan). Dept. of Civil Engineering.
M. Kawahara.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 5.3-5.19, 1980. 9 Fig, 1 Tab, 13 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Finite element analysis, *Mathematical models, *Estuaries, *Water quality, Analytical techniques, Analysis, Approximation method, Salinity, Velocity, Spatial distribution, Discharge(Water), Foreign research, Model studies, *Japan, Two layer flow, Navier-Stokes equations.

The multi-leveled finite element method for the analysis of the current flow in estuaries and coastal seas was discussed. The basic equations can be derived from the three-dimensional Navier-Stokes equations under the several shallow water assumptions. The main assumption is that the pressure distribution in the vertical direction is hydrostatic. A two layer flow model can easily be reduced from the multi-leveled flow model. Following the conventional Galerkin finite element method, the weighted residual equation can be formulated introducing the weighting function. The selection of the interpolation equation is considerably related to the selection of the numerical integration scheme in time. In the case of unsteady analysis, it is necessary to introduce the time marching scheme for time integration. The two step Lax-Wendroff scheme based on the linear interpolation function was employed in this paper. In the case of quasi-steady analysis, the periodic Galerkin method may be employed using the quadratic interpolation equation for velocity and linear interpolation equation for water elevation. The finite element method was successfully applied to the practical planning problems. Two examples were reviewed. (See also W80-06894) (Humphreys-ISWS)

W80-06903

A FINITE ELEMENT SOLUTION FOR DEPTH-AVERAGED TWO-DIMENSIONAL NAVIER-STOKES EQUATIONS FOR FLOWS IN RIVERS AND CHANNELS,
Catholic Univ. of Leuven (Belgium). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W80-06905

THE OPEN BOUNDARY VALUE PROBLEMS IN OCEAN DYNAMICS BY FINITE ELEMENTS,
Toray Industries, Inc., Otsu (Japan). Engineering Research Lab.
T. Tanaka, Y. Ono, and T. Ishise.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 5.47-5.63, 1980. 16 Fig, 14 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Finite element analysis, *Waves(Water), *Coasts, *Mathematical models, Bays, Tidal effects, Tsunamis, Oceanography, Tidal effects, Boundary processes, Analytical techniques, Analysis, Breakwaters, Typhoons, Foreign research, Foreign countries, Wave pile-up, *Japan, Overtopping, Wave run-up.

This paper presented recent results of application of the finite element models to wave overtopping and wave run-up problems in ocean dynamics. Open boundaries were prescribed as a natural boundary condition obtained from the continuity equation of the Galerkin finite element formulation. Typhoon in Ise Bay in 1969, Nankai Tsunami in 1946, and Chilean Tsunami in 1960 are practical examples in computations. The assumptions presented must be verified by comparing them with the field data or experimental results. The results of the computation presented show that the finite element method provides a powerful approach to the ocean dynamics. (See also W80-06894) (Humphreys-ISWS)
W80-06907

FINITE ELEMENT-FRACTIONAL STEPS SOLUTION OF THE 3-D COASTAL CIRCULATION MODEL,
Thessaloniki Univ. (Greece). Dept. of Hydraulics.
C. Koutitas, and B. O'Connor.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 5.64-5.71, 1980. 6 Fig, 13 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Finite element analysis, *Water circulation, *Bays, *Mathematical models, Analytical techniques, Analysis, Velocity, Profiles, Coasts, Methodology, Model studies, Foreign research, *Greece, Three-dimensional model.

This study presented the combined use of the method of finite elements and the method of fractional steps for the solution of the mathematical model for the non steady 3-D circulation in coastal areas due to wind, tide or density variations effects. The method of fractional steps permits the bisection of the differential operator in two parts, the first confined in x and y space and the second confined in the z space. The two parts are integrated separately by use of 2-D finite elements and 1-D finite elements respectively. This avoids the use of 3-D elements and the huge computational volume involved. The application refers to a problem of physical oceanography, the wind-generated circulation in Thessaloniki bay. The steady circulation was reached after 500 time steps (about 12 hours real time). (See also W80-06894) (Humphreys-ISWS)
W80-06908

FINITE ELEMENT ANALYSIS OF DEPTH VARYING FLOW IN LAKES AND COASTAL REGIONS,
Vermont Univ., Burlington. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W80-06909

AN UPWIND FINITE ELEMENT FORMULATION FOR CONVECTION OR BUOYANCY DOMINATED FLOWS IN RIVERS, BAYS AND ESTUARIES,
Atkins Research and Development, Surrey (England).
A. Moult.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 5.103-5.112, 1980. 4 Fig, 7 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Finite element analysis, *Mathematical models, *Estuaries, *Convection, Model studies, Buoyancy, Rivers, Bays, Analytical techniques, Analysis, Water quality, Dispersion, Methodology, Heated water, Waste water disposal, Path of pollutants.

Waste disposal into rivers, bays and estuaries is most economically achieved by means of a side discharge over the full water depth. This investigation was concerned with the development of a method for predicting the velocity and pollutant-concentration fields induced by such discharges. The flow situation was for the case of a right-angle discharge. The discharge jet was bent by the channel cross-flow, forcing the channel flow to deflect towards the far bank. The jet entrainment on the near bank side was restricted, causing a recirculation region to form behind the jet. The low pressure in this zone caused the jet to bend back toward the near bank and attach itself to the wall. The occurrence of a recirculation region was a characteristic feature of full-depth side discharges and considerably complicates the mathematical solution of this problem. A two-dimensional finite element scheme for the calculation of convection dominated flows was described. This scheme combines depth-averaged forms of the governing differential equations with an upwind-difference scheme. The application of the method to the problem of heated side discharge indicated that the behavior of the flow field was reasonable. A comparison with the more conventional finite-difference method proved favorable. (See also W80-06894) (Humphreys-ISWS)
W80-06911

TIDAL WAVE ANALYSIS FOR ESTUARIES WITH INTERTIDAL FLATS,
Hanover Univ. (Germany, F.R.).
K-P. Holz, and G. Nitsche.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 5.113-5.126, 1980. 8 Fig, 14 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Finite element analysis, *Estuaries, *Intertidal areas, *Waves(Water), Tidal effects, Tides, Flow, Analytical techniques, Mathematical models, Model studies, Numerical analysis, Water levels, Coasts, Currents(Water), Tidal waves, Intertidal flats.

The purpose of these investigations was to find a simple but computationally economic strategy for the simulation of tidal flats that could be used for pilot studies. It was then improved to obtain a formulation of high accuracy that could be used even for the study of local details on the tidal flats, and in the channels. Numerical experiments were performed. A model for the computation of tidal wave propagation on tidal flats was presented. A brief review was given, comparing advantages of explicit and implicit formulations with respect to simulation strategies of intertidal flats. Numerical results were given for both a simplified and an accurate strategy with moving boundaries. The latter was highly superior to the former in the tidal flat region. (See also W80-06894) (Humphreys-ISWS)
W80-06912

APPLICATION OF THE FINITE ELEMENT METHOD TO PERIODIC TIDAL COMPUTATION,
Brussels Univ. (Belgium). Service des Milieux Continus.
G. Warzee, M. A. Sterling, and Y. Adam.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol.), Mississippi University, Oxford, May 19-23, 1980. p 5.127-5.137, 1980. 8 Fig, 12 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Finite element analysis, *Tides, *Mathematical models, *Water levels, Waves(Water), Analytical techniques, Analysis, Coasts, Model studies, Methodology, English Channel.

The finite element method was applied to the solution of the fundamental mode of the M2 tide in the English channel. The use of quadratic isoparametric elements together with numerical integration allows an easy treatment of the complex geometry (coastal geometry, mean water depths) and of the non linear equations. The computed solutions show a very good agreement with the numerical results as well as with experimental data. This solution can be used as initial guess for the real tide computed with a time marching program allowing a reduction of the number of preliminary steps necessary to dump the spurious effects of the initial conditions. (See also W80-06894) (Humphreys-ISWS)
W80-06913

TIDAL COMPUTATION IN THE ELBE ESTUARY WITH A COUPLED FE MODEL,
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydromechanik.
B. Herrling.
In: Finite Elements in Water Resources, Vol 2; Preprints of the Third International Conf. (2 Vol), MS Univ., Oxford, May 19-23, 1980. p 5.138-5.147, 1980. 8 Fig, 9 Ref. Science and Education Admin., New Orleans, LA.

Descriptors: *Finite element analysis, *Estuaries, *Mathematical models, *Tides, Tidal waters, Analytical techniques, Analysis, Water levels, Model studies, Hydrographs, Foreign research, Velocity, Currents(Water), *Elbe Estuary(Germany).

The computation of tidal motion within large areas of an estuary requires much effort using big computers if a river basin with complex geometry has to be included. In the first step demonstrated, it was proved that water levels and discharges can be correctly computed by the model for the whole estuary region. The author modeled the region of the Elbe River and the channel system on the inter-tidal flats by using a one-dimensional analysis, while the south-eastern part of the North Sea and the outer Elbe River were simulated two-dimensionally. Applying the implicit finite element method, the problem involved prescribing the boundary conditions at the nodes common to both parts of the estuary model. This was solved by coupling directly the one- and two-dimensional elements, so that all unknown parameters are calculated from only one set of equations in every time step. The numerical results showed that the new coupling method is qualified to analyze the dynamics of estuaries. It was emphasized that by using a one-dimensional analysis in parts of the model much computer time can be saved. Also, in applying the new coupling mechanism it is possible to reproduce special parts of a model by a two-dimensional discretion, e.g., the area of construction in a river. (See also W80-06894) (Humphreys-ISWS)
W80-06914

NUMERICAL METHODS FOR TIDAL PROPAGATION APPLIED TO A HYBRID MODEL OF THE BAY OF FUNDY,
National Research Council of Canada, Ottawa (Ontario). Hydraulics Lab.
M. Rahman, D. Prandle, L. Spraggs, and V. Argintaru.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2

Vol.), Mississippi University, Oxford, May 19-23, 1980. p 5.148-5.157, 1980. 3 Fig, 1 Tab, 7 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Finite element analysis, *Mathematical models, *Tides, *Bays, Numerical analysis, Water levels, Hydraulic models, Model studies, Analytical techniques, Analysis, *Bay of Fundy, Hybrid models, Explicit schemes, Implicit schemes, Finite difference analysis.

One part of the feasibility studies for the Bay of Fundy tidal power project may involve the construction of an hydraulic scale model of the region surrounding the tidal barrier. This scale model is dynamically interfaced with a numerical model of the outer sea region. The two models then operate concurrently, constituting a hybrid model of the complete tidal system. This paper examined the merits of various numerical schemes, particularly their effectiveness as part of ahybrid system. Comparisons were made on the basis of: (1) operational time, (2) storage requirement, (3) accuracy, and (4) programming effort. The problem of tidal propagation in a rectangular region of constant depth forms the basis for comparing the various schemes. An analytical solution for this problem was presented. (See also W80-06894) (Humphreys-ISWS)
W80-06915

FINITE ELEMENT COMPUTATION OF SOME TIDAL SPECTRAL COMPONENTS,
Grenoble Univ-1 (France). Inst. de Mecanique.
C. Le Provost, A. Poncet, and G. Rougier.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol.), Mississippi University, Oxford, May 19-23, 1980. p 5.158-5.168, 1980. 6 Fig, 9 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Finite element analysis, *Tides, *Mathematical models, *Forecasting, Analytical techniques, Mathematical studies, Methodology, Sea level, Equations, Water levels, Currents(Water), Fourier analysis, Model studies, Tidal waters, Harbors, *English Channel, Spectral analysis.

It is difficult to make exact predictions of tidal sea surface elevations and currents: The classical numerical models used are expensive; they are time dependent and need high order accuracy schemes because of nonlinear processes occurring in shallow water areas; however, in harbors where harmonic constituents can be deduced from tidal in situ records, the harmonic methods are successfully used for sea-surface height predictions. Computations of some other nonlinear components are needed in order to complete the tidal spectrum in areas such as the English Channel, following the harmonic method presented. This finite element model can be used without difficulty and was developed to compute the main components of the tide in any oceanic or coastal basin so that the harmonic method may be employed asa possibility for predicting tides over the entire area under investigation. It also offers greater accuracy at a lower cost than other classical time dependent numerical models. (See also W80-06894) (Humphreys-ISWS)
W80-06916

MODELING OF SHORT WAVES USING THE FINITE ELEMENT METHOD,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulic Lab.
J. R. Houston.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol.), Mississippi University, Oxford, May 19-23, 1980. p 5.181-5.195, 1980. 9 Fig, 19 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Finite element analysis, *Waves(Water), *Mathematical models, *Coastal structures, Wavelengths, Shoals, Breakwaters, Islands, Frequency, Velocity, Analytical techniques, Hydraulic models, Model studies, Short waves.

An important class of waves have wavelengths sufficiently short so that frequency dispersion effects are important. For example, wind waves (4- to 15-sec periods) in the nearshore region play an important role in the movement of sediment and also can cause ship mooring problems within harbors. There are two major difficulties involved in modeling short waves. First, it is difficult to model frequency dispersion for waves propagating over arbitrary and variable depths. Second, in order to resolve short waves, numerical models must employ such small grid cells that simulations covering areas of practical importance are not feasible. This paper described a two-dimensional finite element numerical model that solves an equation that includes the effect of frequency dispersion to the first order, and that is sufficiently efficient to be applied to practical problems. Applications of the model to combined refraction-diffraction problems involving short waves were presented. The finite element numerical model presented, accurately simulates short wave propagation and interaction with structures. (See also W80-06894) (Humphreys-ISWS)
W80-06918

NUMERICAL SIMULATION OF BREAKING WAVES,
Norges Tekniske Hoegskile, Trondheim. Div. of Marine Hydrodynamics.
T. Vinje, and P. Brevig.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol.), Mississippi University, Oxford, May 19-23, 1980. p 5.196-5.210, 1980. 10 Fig, 4 Ref, 1 Append. Science and Education Administration, New Orleans, LA.

Descriptors: *Mathematical models, *Waves(Water), *Potential flow, Simulated analysis, Mathematical studies, Analytical techniques, Analysis, Numerical analysis, Equations, Currents(Water), Profiles, Theoretical analysis, Breaking waves.

Longuet-Higgins and Cokelet developed a numerical technique for solving the periodic, two-dimensional, deep water breaking wave problem. This method is based on potential theory and a conformal mapping of the physical plane inside a closed contour in the mapped plane in which the equations of motion are solved. The wave form in the physical plane is then found by an inversion of the mapping. Details about the numerical techniques and the time integration procedures are found in the references. In this paper the authors presented a similar method. This is stated in the same way except that the problem was solved in the physical plane and finite depth was introduced. The advantage of working in the physical plane is that certain other effects can be included with little modification of the program. The calculations are based on potential theory. In addition, the fluid motion is assumed to be tow-dimensional and the wave is assumed to be periodic in the horizontal direction. From an initial configuration, the development of the breaking was integrated in time until the breakers's jet hit the wave front. Data presented showed good agreement between the wave profile of the model wave and the numerically simulated wave. (See also W80-06894) (Humphreys-ISWS)
W80-06919

FINITE ELEMENT ANALYSIS OF WAVE TRANSMISSION THROUGH A BELL-MOUTH INLET,
Indian Inst. of Tech., Madras (India). Dept. of Civil Engineering.
T. C. Gopalakrishnan, and J. L. Machemehl.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol.), Mississippi University, Oxford, May 19-23, 1980. p 5.211-5.219, 1980. 4 Fig, 2 Ref. Science and Education Administration, New Orleans, LA. NOAA 04-8-M01-16.

Descriptors: *Finite element analysis, *Waves(Water), *Inlets(Waterways), *Mathematical models, Coasts, Channels, Harbors, Analytical techniques, Analysis, Model studies, Bell-mouth inlet.

A combined two-dimensional and one-dimensional finite element model was used to analyze the effects of waves passing bell-mouth entries in harbor channels. The quartic polynomial in two dimensions and the Hermitian cubic were adopted as the shape functions in the two-dimensional and one-dimensional regions respectively. Based on this combined model, results were obtained for different aspect ratios of elliptic bell-mouths. It appears that this approach provides a powerful method to analyze different situations while developing the design of a harbor channel. (See also W80-06894) (Humphreys-ISWS)
W80-06920

FINITE ELEMENT MODELS IN A HYBRID MODEL STUDY OF ESTUARINE SEDIMENTATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
W. H. McAnally, Jr., and W. A. Thomas.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol.), Mississippi University, Oxford, May 19-23, 1980. p 6.47-6.56, 1980. 1 Fig, 9 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Model studies, *Estuaries, *Columbia River, Finite element analysis, Sedimentation, Computer models, Reviews, Hybrid models.

This paper described how two finite element models fit into a hybrid solution method, and discussed experience gained in their application. Water surface elevation, current velocity, and salinity (in three dimensions) are measured briefly at a number of points in a physical model of the estuary. These measurements are used to drive a finite element numerical model for hydrodynamics--RMA-2. Output from RMA-2 and other models as required (e.g., a wind-wave propagation model) drives a two-dimensional finite element numerical model for sediment transport--STUDH. The several models are connected and complemented by a data management system and several pre- and post-processor computer codes. Present criteria for limits on element sizes, shapes, and time steps appear to be lacking. Rules of thumb and previous experience with what works and what does not are valuable guides, but practical, production-oriented model applications generally require that meshes be stretched to the limit in order to stay within time, cost, and computer resources. A related need is for continuing improvement in computational efficiency--a popular area of endeavor. Recent work made the finite element method competitive with other methods, but further improvements are a necessity. (See also W80-06894) (Humphreys-ISWS)
W80-06924

FINITE ELEMENT ANALYSIS OF THERMAL CONVECTION IN DEEP OCEAN SEDIMENTS,
Sandia National Labs., Albuquerque, NM. Heat Transfer and Fluid Mechanics Div.
D. K. Gartling.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 7.30-7.44, 1980. 8 Fig, 17 Ref. Science and Education Administration, New Orleans, LA. DOE DE-AC04-76DP00789.

Descriptors: *Finite element analysis, *Mathematical models, *Convection, *Radioactive waste disposal, Oceans, Flow, Analytical techniques, Heating, Numerical analysis, Waste disposal, Sediments, Oceanography, Heat transfer, Porous media, Darcys law, Isotherms, Thermal convection, Ocean sediments.

The fluid mechanical and heat transfer process occurring in oceanic sediments may be characterized as free (or natural) convection in a porous material. The introduction of a local heat source, such as a waste canister, into a saturated sediment layer would by itself initiate a convection process due to buoyancy forces. The general boundary value problem of heat and mass transfer in a porous media was described. Based on a Galerkin form of the finite element method, a numerical procedure was developed that was suitable for both steady-state and transient problems of con-

vective heat transfer. The utility of the proposed scheme was illustrated through the study of two problems involving flow in oceanic sediments. Through the diversity of the studies undertaken, it is apparent that the finite element procedure proposed provides a versatile and powerful tool for the solution of engineering problems as well as the study of fundamental physical phenomena. (See also W80-06894) (Humphreys-ISWS)
W80-06927

THE MOVING INTERFACE PROBLEM WITH FINITE ELEMENTS,
Sydney Univ., (Australia). Dept. of Aeronautical Engineering.
For primary bibliographic entry see Field 2A.
W80-06930

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

DESALTING DEMONSTRATION PLANT FEASIBILITY STUDY, ALAMOGORDO, NEW MEXICO.
Kaiser Engineers, Inc., Oakland, CA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-222292, Price codes: A07 in paper copy, A01 in microfiche. Kaiser Engineers Report No. 79-29-R. Prepared for the Office of Water Research and Technology, September 1979. 74 p, 26 Fig, 17 Tab, 9 Ref. OWRT (No 9608) (1), 14-34-001-9608.

Descriptors: *Desalination processes, *Electrodialysis, *Reverse Osmosis, *Membrane processes, Ion exchange, Heat exchangers, Pilot plants, Desalination apparatus, Desalination plants, Desalination, Water treatment, Water supply, Potable water, Saline Water, Water sources, Planning, Costs, Evaluation, *New Mexico, Alamogordo(NM).

The feasibility of implementing a desalting demonstration plant in Alamogordo, New Mexico, was investigated. Water supply quality and quantity problems were identified and alternative water sources evaluated. Desalting was found to be the least expensive reliable method of supplying water which would meet drinking water quality standards. Four alternative sites were evaluated. The site adjacent to the existing Alamogordo water filtration plant was selected due to its proximity to Alamogordo and the opportunity for consolidating existing water treatment facilities. A plant product water capacity of 2 million gallons per day was recommended to demonstrate the applicability of desalting demonstration processes for municipal water supply. Six desalting process alternatives were evaluated based on the following criteria; ease of expansion, cost, demonstration project potential, energy usage, environmental considerations, reliability, and product water quality. Electrodialysis with polarity reversal was ranked first and two-state reverse osmosis was ranked second. Preliminary designs of desalting plants using these processes were developed. Construction and operating cost estimates were prepared for each of these designs. The most favorable means of brine disposal would be evaporation-percolation ponds in an area west of Alamogordo. (Dawyot-Kaiser)
W80-06451

DESALTING DEMONSTRATION PLANT FEASIBILITY STUDY, VIRGINIA BEACH, VIRGINIA.
Kaiser Engineers, Inc., Oakland, CA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-222235, Price codes: A07 in paper copy, A01 in microfiche. Kaiser Engineers Report No. 79-30-R. Prepared for Office of Water Research and Technology, September 1979. 87 p, 29 Fig, 18 Tab, 19 Ref. OWRT (No 9608) (2).

Descriptors: *Desalination processes, *Electrodialysis, *Reverse Osmosis, *Membrane Processes, Ion exchange, Heat Exchangers, Pilot Plants, Desalination apparatus, Desalination plants, Desalination, Water treatment, Water supply, Potable water, Saline water, Water sources, Planning, Costs, Evaluation, *Virginia Beach(VA).

The feasibility of implementing a desalting demonstration plant in Virginia Beach, Virginia, was investigated. Water supply quality and quantity problems were identified and alternative water sources evaluated. Desalting was found to be a reliable currently available method of supplying water which would meet drinking water quality standards. Five alternative sites were evaluated. A site close to the existing water distribution system and to brine disposal sites was selected. A plant product water capacity of 2 million gallons per day was recommended to demonstrate the applicability of desalting demonstration processes for municipal water supply. Six desalting process alternatives were evaluated based on the following criteria; ease of expansion, operating cost, demonstration project potential, energy usage, environmental considerations, reliability, and product water quality. Two-state reverse osmosis (RO) was ranked first. Preliminary design of a two-state RO desalting plant was prepared. As an alternate, the preliminary design for an electrodialysis desalting system utilizing polarity reversal and using separate sources for feedwater and concentrate makeup was prepared. Construction and operating cost estimates were also prepared for each of these designs. Conveyance of brine to Little Creek Cove, on Chesapeake Bay, would be the most favorable means of brine disposal. (Dawyot-Kaiser)
W80-06452

DRAFT ENVIRONMENTAL ASSESSMENT DESALTING DEMONSTRATION PLANT, ALAMOGORDO, NEW MEXICO.
Kaiser Engineers, Inc., Oakland, CA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-100646, Price codes: A05 in paper copy, A01 in microfiche. Report No 79-58-RE to Office of Water Research and Technology, U.S. Department of the Interior, August 1979, 78 , 7 Fig, 5 Tab, 18 Ref. OWRT (no 9608) (3) 14-34-0001-9608.

Descriptors: *Desalination plants, *Desalination processes, Desalination wastes, Environmental effects, *Facilities, Assessments, Wells, Demonstration plant, *Brackish water, Groundwater, Demineralization, Aquifers, Potable water, Regulation, Regions, Seismology, Ecosystems, Hydrology, Water quality, Land use, Water resources, Rocky Mountain Region, New Mexico, *Alamogordo(NM).

This Environmental Assessment was part of Kaiser Engineers' study, Desalting Demonstration Plant Feasibility Study, Alamogordo, New Mexico. Product water from the proposed plant would supplement and improve city water quality to meet drinking water standards, which now has natural but high total dissolved solids (TDS), especially containing Na, Ca, Mg, chloride, bicarbonate, and sulfate. The plant would be erected near the present La Luz filter plant, about 4 mi north of the city, and would use 2.5-3 million gallons per day (mgd) of brackish water (containing about 1800 ppm of TDS) from 3 wells to produce 2 mgd of potable water and 0.6 mgd of brine. The brine (10,000 ppm TDS) would be piped about 6 mi west to an evaporation/percolation pond having a higher groundwater TDS than the brine. This Assessment finds that short-term (dust generation during construction) and longer-term (groundwater withdrawal from the Tularosa Basin alluvium aquifer, and pond disposal of brine) impacts will be minimal, based on inital data. Animal and plant life at the proposed site is minimal. (Zielinski-IPA)
W80-06702

DRAFT ENVIRONMENTAL ASSESSMENT DESALTING DEMONSTRATION PLANT, VIRGINIA BEACH, VIRGINIA.
Kaiser Engineers, Inc., Oakland, CA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-100653, Price codes: A06 in paper copy, A01 in microfiche. Report No 79-57-RE to Office of Water Research and Technology, U. S. Department of the Interior, August 1979. 96 p, 7 Fig, 11 Tab, 23 Ref. OWRT (no 9608) (4), 14-34-0001-9608.

Descriptors: *Desalination plants, *Desalination processes, Desalination wastes, Environmental effects, *Facilities, Assessments, Wells, Groundwater, *Brackish water, Demineralization, Potable water, Regions, Atlantic coastal plain, Virginia, Aquifers, Economics, Water resources, Ecosystems, Fishes, Land use, Geology, Surface water, Water quality, *Virginia Beach(VA).

This Environmental Assessment was part of Kaiser Engineers' study, Desalting Demonstration Plant Feasibility Study, Virginia Beach, Virginia. Product water from the proposed plant would provide availability of a greatly needed new domestic potable water source to provide time for alternative water resources development, and would have high socioeconomic benefits for projected population/economic development in the Virginia Beach area. The plant would be erected near Little Creek Cove, and would use a total of 2.5 million gallons per day (mgd) of brackish feedwater from 2-3 wells containing about 4000 ppm total dissolved solids (TDS). The plant would generate an average 0.5 mgd of brine discharge (20,000-25,000 ppm TDS) into Little Creek Cove (22,000 ppm TDS), which has a mean sea level volume of 2.3 billion gallons. Longer-term effects/impacts may include potentiometric surface lowering of the Lower Cretaceous Aquifer. The impact on brine disposal into Little Creek Cove should be insignificant. Short-term use and long-term effect of plant operation are deemed insignificant. (Zielinski-IPA)
W80-06703

APPARATUS FOR PRODUCING SWEET WATER,
B. W. Hanning.
U.S. Patent No. 4,187,151, 8 p, 5 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 991, No 1, p 244, February 5, 1980.

Descriptors: *Patents, *Desalination, *Desalination apparatus, Sea water, Waves(Water), Condensation, Separation techniques.

A simple desalination device is described. A base with a transparent or translucent chamber floats on the surface of a body of salt water. Waves cause the chamber to expand and contract, and valves cause air to be pumped through the chamber. The moisture laden air leaving the chamber is led to a condensation and collection tank below waterlevel. (Sinha - OEIS)
W80-06943

3B. Water Yield Improvement

EXPANDED POLYSTYRENE SPHERES AS EVAPORATION SUPPRESSORS,
Mosul Univ. (Iraq). Coll. of Engineering.
T. A. Mahmoud, and N. K. Bashi.
Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol 106, No IR3, Proceedings Paper 15689, p 163-173, September 1980. 7 Fig, 2 Tab, 12 Ref, 1 Append.

Descriptors: *Evaporation control, *Monomolecular films, *Plastics, *Retardants, Evaporation, Reservoirs, Water temperature, Dissolved oxygen, Water quality, Water resources, Water conservation, Polystyrene, Polystyrene beads, Floating beads, Water covering.

Tests were made both under indoor and outdoor conditions using land and floating pans covered with beads to produce various water surface coverage. Daily measurements of evaporation and water temperature were recorded. Dissolved oxygen measurements were also performed separately to determine the effect of various covers on oxygen transfer. Solar radiation and wind are the two factors responsible for the difference in evapo-

ration between the indoor and outdoor conditions. When applied on an artificial pond, the beads easily spread themselves on the water surface. There was insignificant temperature increase of the water under polystyrene cover as compared to the combined cover which adds to the credit of the material. No interference with the oxygen exchange was observed due to the combined cover and polystyrene beads. (Sims-ISWS)
W80-06825

3C. Use Of Water Of Impaired Quality

USE OF SALINE WATER IN ENERGY DEVELOPMENT,
Utah Water Research Lab., Logan.
C. E. Israelsen, V. D. Adams, J. C. Batty, D. B. George, and T. C. Hughes.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-102980, Price codes: A07 in paper copy, A01 in microfiche. Water Resources Planning Series UWRL/P-80/04, June 1980. 128 p, 71 Fig, 43 Tab, 4 Append. OWRT-C-80322-S (no 8553) (1), 14-34-0001-8553.

Descriptors: *Saline water, Brackish water, Groundwater, Cooling tower, *Cooling water, *Powerplants, Model studies, Coal-fired powerplant cooling, *Colorado River basin, Coal slurry, *Energy development, Upper Colorado River basin.

Maps were made of the Upper Colorado River Basin showing locations of coal deposits, oil and gas, oil shale, uranium, and tar sand, in relationship to cities and towns in the area. Superimposed on these are locations of wells showing four ranges of water quality; 1,000-3,000 mg/1, 3,000-10,000 mg/1, 10,000-35,000 mg/1, and over 35,000 mg/1. Information was assembled relative to future energy-related projects in the upper basin, and estimates were made of their anticipated water needs. Using computer models, various options were tested for using saline water for coal-fired power plant cooling. Both cooling towers and brine evaporation ponds were included. Information is presented of several proven water treatment technologies, and comparisons are made of their cost effectiveness when placed in various combinations in the power plant makeup and blow-down water systems. A relative value scale was developed which compares graphically the relative values of waters of different salinities based on three different water treatment options and predetermined upper limits of cooling tower circulating salinities. Samples were analyzed in the laboratory to determine which constituents had been leached from or absorbed by the coal, and what possible deleterious effects this might have on the burning properties of the coal, or on the water for culinary use or irrigation.
W80-06698

HEAT TRANSPORT IN GROUNDWATER SYSTEMS, VOLUME I: FINITE ELEMENT MODEL,
Texas Water Resources Inst., College Station.
E. K. Grubaugh, and D. L. Reddell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-104127, Price codes: A09 in paper copy, A01 in microfiche. Technical Report No. 104-Vol. I, August 1980. 188 p, 16 Fig, 4 Tab, 49 Ref,4 Append. OWRT-A-039-TEX (1), 14-34-0001-7091.

Descriptors: Numerical analysis, Groundwater, *Solar radiation, Aquifers, *Heat transfer, Heated water, *Model studies, Equations, Temperature, Pressure, Energy, *Thermal water, Thermal stratification, Solar energy, Solar collectors, Testing procedures, *Injection wells, Aquifer characteristics, *Water reuse.

A numerical simulation model was developed to predict the response of a multiple groundwater aquifer to the operation of an injection and pumping wells system transporting hot water (heated by solar collectors) for long-term aquifer storage of solar energy. The objectives included the development of numerical models to evaluate the non-steady, areal, hydrostatic pressure distribution and water movement, and to evaluate the non-steady, areal, heat transfer and temperature distribution, in a multiple aquifer groundwater system. The developed models were then combined into a numerical simulation that would predict water temperature and pressure throughout the aquifer system when hot/cold pumping and injection wells are operated. The resultant numerical model allows accurate prediction of fluid pressures and location of the sharp thermal front. Application to a variety of convention-conduction groundwater problems is possible. Appendices contain a simulated flow chart, derivations of equations, computer program listings, and vector operations. The developed numerical model simultaneously solved the groundwater flow and energy transport equations, using a finite difference approximation for the time derivative and 3-dimensional Galerkin-finite element approximations for the space derivatives. (See also W80-06700) (Zielinski-IPA)
W80-06699

HEAT TRANSPORT IN GROUNDWATER SYSTEMS, VOLUME II: LABORATORY MODEL,
Texas Water Resources Inst., College Station.
D. B. Reed, and D. L. Reddell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-104135, Price codes: A08 in paper copy, A01 in microfiche. Technical Report No 104 - Vol II, August 1980. 158 p, 32 Fig, 3 Tab, 42 Ref, 2 Append. OWRT-A-039-TEX (2), 14-34-0001-7091.

Descriptors: *Solar radiation, Groundwater, Aquifers, *Heat transfer, Heated water, *Model studies, Numerical analysis, Solar energy, Solar collectors, Measurement, Pressure, Temperature, Energy, Energy dissipation, Thermal conductivity, Thermal properties, Physical properties, Pumps, *Thermal water, *Injection wells, Aquifer characteristics, *Thermal energy, *Water reuse.

A laboratory model tank (1.8288 in deep, 0.2 radian sector, with 7.01 m in the radial direction) was constructed to simulate injection of hot water (heated from solar collectors) into a confined aquifer. Temperature and pressure data were taken to monitor the hot water front as it moved through the model. Temperatures were measured at 6 different radial distances from the well and 7 vertical heights above the bottom of the flow layer. Four runs were made with water supplied to the tank at constant temperature and flow rate, one in which no heat transfer occurred and hydraulic conductivity was measured, three in which heat transfer was monitored. For the latter runs, hydraulic conductivity increased as aquifer temperature increased. Injection rates were only indirectly related to thermal efficiency, for which the flow layer thickness had the greatest effect. As thickness increased, thermal efficiency increased. Since an angular symmetry assumption was not met, the model did not simulate the injection and pumping of hot fluid into a confined aquifer. It is suggested that a numerical model be developed that models the laboratory model and that the data obtained could be used for numerical model validation. (See also W80-06699)(Zielinski-IPA)
W80-06700

3D. Conservation In Domestic and Municipal Use

NATIONAL CONFERENCE ON WATER CONSERVATION AND MUNICIPAL WASTEWATER FLOW REDUCTION.
Environmental Protection Agency, Washington, DC. Facility Requirements Div.
Proceedings, Conference held November 28, 29, 1978, Chicago, IL, EPA/430/9-79-015, August 1979. 288 p, 15 Fig, 29 Tab, 106 Ref. 68-03-2674.

Descriptors: *Water conservation, *Municipal water, *Municipal wastes, *Conferences, Conservation, Waste water disposal, Environmental effects, Water utilization, Water policy, Wastes, Water management, Water resources, Regulation, Economics, Costs, Land use, Water quality, Water reuse, Reclaimed water.

Papers in this Proceedings are grouped into six major topic area sessions, covering perspective on the problem, regulation of water resource, water conservation technology, education and public participation, water and waste water management issues, and case studies of water resource management, with each section comprised of 4-6 papers. The text of President Carter's June 6, 1978 message to the Congress on Federal Water Policy, an overview paper by J. G. Speth of the Council on Environmental Quality, and five papers from EPA representatives are included in the 30 papers given. Other papers were presented by various Federal, State, county, university, and private business representatives. The Conference was funded by the Facility Requirements Division, Office of Water Programs, U.S. Environmental Protection Agency through the Environmental Research Information Center (Cincinnati). (Zielinski-IPA)
W80-06647

3E. Conservation In Industry

REUSE OF FERMENTATION BRINES IN THE CUCUMBER PICKLING INDUSTRY: EXECUTIVE SUMMARY,
Michigan State Univ., East Lansing. Dept. of Food Science and Human Nutrition.
R. F. McFeeters, W. Coon, M. P. Palnitkar, M. Velting, and N. Fehringer.
Environmental Protection Agency, Industrial Environmental Research Laboratory, Cincinnati, Ohio (1978). 11 p, 1 Fig, 2 Tab. S-803825.

Descriptors: *Food processing industry, *Brines, *Recycling, Heat treatment, Chemicals, Treatment, Circulation, On-site investigations, Economics, Vegetable crops, Cost-benefit analysis, Quality control, Fungi, Fungicides, Operations research, Feasibility studies, *Cucumber brine reuse, Cucumber pickling industry, Fermentation brines.

The commercial, technological, and economic feasibility of recycling spent cucumber fermentation brine from the processed cucumber pickling industry was investigated and the results indicate that brine recycling is practical on a commercial scale. Heat or chemical treatments of the spent brine were used and studies were carried out to determine the adequacy of these brine treatment procedures. Heat treatment of the spent brine for 30 sec at 90.5 degrees C destroyed 99.98% of the pectinases from fungi common on cucumber fruits and flowers. The Penicillium janthinellum pectinase activity was reduced to 1% of the original activity by raising the 72 degree F brine pH to 11.2 or higher for at least 37 hr. No significant accumulations of metals or pesticides were found to occur in the brine recycling and the brine can be reused for at least three fermentations with no decrease in the quality of the pickles. The heat treatment process gave a small net savings and the chemical treatment gave a small net cost, although plant economics will depend on local conditions. (Sidney-IPA).
W80-06562

INEXPENSIVE PURIFICATION OF UREA WASTE STREAMS,
Standard Oil Co. (OH), Cleveland. (Assignee).
For primary bibliographic entry see Field 5D.
W80-06950

3F. Conservation In Agriculture

AUTOMATIC LIQUID FLOW CONTROL DEVICE,
D. D. Moore.
U.S. Patent No 4,182,371, 7 p, 8 Fig, 3 Ref; Official Gazette of the United States Patent Office, Vol 990, No 2, p 516, January 8, 1980.

Descriptors: *Patents, *Irrigation, *Water control, Flow control, Automatic control, Irrigation efficiency, Equipment, Valves, Flow control device.

An automatically actuated liquid flow control device or valve is provided which serves to start or stop the flow of a liquid, e.g., water, through a supply line at a desired time or, in the case of stopping the flow of a liquid, after a predetermined amount of liquid has passed through the valve. The liquid flow control valve includes an expandable balloon-like bladder or reservoir. The automatic liquid flow control valve is particularly adapted for use in conjunction with lawn or garden watering systems or fields to be irrigated at night with the flow of water being started to stop at a predetermined time or after a predetermined amount of water has been delivered. (Sinha - OEIS)
W80-06458

METHOD OF CONTROLLING THE RELATIVE HUMIDITY IN A SOIL ENVIRONMENT AND APPARATUS FOR ACCOMPLISHING SAME,
L. Ornstein.
U.S. Patent No 4,182,357, 8 p, 5 Fig, 15 Ref; Official Gazette of the United States Patent Office, Vol 990, No 2, p 510, January 8, 1980.

Descriptors: *Patents, *Irrigation, *Soil moisture, *Soil-water-plant relationships, Soil physical properties, Hygrometry, Automatic control, Water conservation, Water delivery, Relative humidity control.

A method and apparatus are disclosed for controlling the relative humidity of a soil environment at a pre-set value using an enclosed volume of a water-soluble or water-swellable material. The enclosed volume is separated from the external environment by a relatively stiff and strong semipermeable membrane and is separated from a pressurized irrigation water supply by a water-impermeable constrictable flexible section or diaphragm in the supply line. When the soil is more moist than the pre-set value, intake of water through the membrane causes expansion of the water-swellable material which in turn constrict the flexible section of the water supply line to interrupt the flow of water to the soil. When the soil moisture falls below the pre-set value, egress of water from the water-swellable material releases the constricting force on the flexible section thereby allowing increased flow of water through the flexible section of supply line to the soil. This process, which is called hygrostatic irrigation, is especially useful for optimized and unattended control and delivery of water to the root system of a plant growing in soil as well as for water conservation in the agricultural irrigation of arid regions. It also permits the optimized delivery to a plant, on a continuous basis in proportion to the water consumed, of nutrients, e.g. fertilizers dissolved at appropriate low concentrations in the supply water. (Sinha - OEIS)
W80-06459

SELF-PROPELLED IRRIGATION APPARATUS,
L. C. Murray.
U.S. Patent No 4,182,493, 7 p, 225 Fig, 5 Ref; Official Gazette of the United States Patent Office, Vol 990, No 2, p 558, January 8, 1980.

Descriptors: *Patents, *Irrigation systems, *Sprinkler irrigation, Application equipment, Lateral conveyance systems, Irrigation practices, Irrigation efficiency, Self-propelled apparatus(Irrigation).

A sprinkler irrigation system is adopted to be moved along a pressurized water supply line. The apparatus includes valves placed at predetermined intervals along the upper surface of the water supply pipe. The valves are connected with the interior of the pipe through apertures. The valves have gates which are actuated by longitudinally-extending levers along-side the valve housing. A self-propelled trolley on wheels runs along the water supply pipe. Mounted on the trolley are a valve actuating mechanism and a water receptable. The valve actuating mechanism has a housing and lowers itself over the valve on the water pipe as it moves forward and thereby depresses the level to open the valve gates, permitting the water to pass from the pipe to the water receptable. The water passes from the water receptable to the distribution system which is comprised of a secondary water pipe extended laterally outwardly from the trolley along one or more self-propelled towers. Sprinkling devices can be attached along the pipe. An alignment device on the pipe at each tower is connected to the tower propulsion unit, and maintains the tower in alignment with the trolley to prevent breaks or bends in the secondary water pipe. (Sinha - OEIS)
W80-06461

ANTI SIDE SPLASH DRIVE ARM FOR AN IMPACT DRIVE SPRINKLER,
Anthony Mfg. Corp., Azusa, CA (Assignee).
W. J. Wichman, and R. W. Patterson.
U.S. Patent No 4,182,494, 8 p, 7 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 990, No 2, p 558, January 8, 1980.

Descriptors: *Patents, *Irrigation systems, *Sprinkler irrigation, Application equipment, Irrigation practices, Irrigation efficiency.

A new and improved drive arm for an impact drive sprinkler which occupies relatively little space is capable of effectively driving the sprinkler in the forward and reverse directions when operating at relatively low supply pressures. This is accomplished generally by a new reaction member on the arm which deflects the stream of water ejected from the nozzle of the sprinkler through a first obtuse angle thereby directing the stream rearwardly with respect to its original direction, and then through a second obtuse angle, approximately equal to the first angle, and ejects the stream of water in a direction substantially parallel to the stream ejected from the nozzle. By this arrangement the sprinkler is capable of operating effectively in both full and part circle applications and the undesirable side splash is eliminated during operation. (Sinha - OEIS)
W80-06462

UNDERGROUND PERCOLATION HEAD AND WATERING SYSTEM,
R. McEntyre.
U.S. Patent No 4,182,583, 4 p, 3 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 990, No 2, p 588, January 8, 1980.

Descriptors: *Patents, *Irrigation systems, *Subsurface irrigation, Application equipment, Irrigation operation and maintenance, Irrigation efficiency.

This invention relates generally to underground irrigation systems and more specifically to the equipment required by such systems in the form of pipes, covers, valves and the like. This invention provides a means by which existing conventional surface sprinkling systems may be easily converted to the underground variety. The percolation head is essentially a cover spaced apart from and sized to make with the upper surface of an underground water distribution pipe through which holes are provided along the upper surface of the pipe for releasing the water. When mated with a pipe and over an opening in it, the entire lower half of the head forms an enlarged space open to the ground through which water is allowed to directly percolate into the ground, although the actual opening for the water is not in direct contact with the ground preventing dirt from clogging the openings. (Sinha - OEIS)
W80-06465

BAYESIAN ANALYSIS OF ENERGY PRICES ON IRRIGATION,
Arizona Univ., Tucson. Dept. of Agriculture Economics.
R. J. McAniff, M. Flug, and J. Wade.
Journal of the Water Resources Planning and Management Division, ASCE, Vol 106, No WR2, Proc. Paper 15548, p 401-408, July 1980. OWRT A-089-ARIZ (2), 14-34-0001-9003.

Descriptors: *Energy, Flood irrigation, *Irrigation systems, Prices, Pricing, *Cost analysis, Sprinkler irrigation, *Pumping, Costs, Evaluation, *Bayes theorem.

Recent increases in the price of energy for pumping water and declining aquifers have resulted in a reevaluation of irrigation systems, techniques and practices. Given various projected energy price increases, the agricultural producer is faced with the problem of selecting that strategy which minimizes the costs of irrigation over the life of the system. The available systems provide a range of choices from energy efficient capital intensive systems to less expensive systems which may utilize more energy. Since future energy costs are unknown, a choice must be made in which one of the variables is stochastic in nature. By considering the probabilities of future energy price increases, an irrigation system can be selected that minimizes long-run expected costs. A decision framework that may be utilized for optimal system selection is based on Bayesian decision theory, a method in which prior information is incorporated with additional information to estimate revised probabilities for decision making.
W80-06505

A DECISION ANALYSIS FRAMEWORK FOR EVALUATING COSTS OF WATER APPLICATION IN PRODUCTIVE AGRICULTURE,
Arizona Univ., Tucson. Dept. of Agricultural Economics.
J. C. Wade, R. J. McAniff, and M. Flug.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-223894, Price codes: A03 in paper copy, A01 in microfiche. Project Completion Report, July 1980. 29 p, 4 Fig, 9 Tab, 23 Ref. OWRT A-089-ARIZ (1), 14-34-0001-9003.

Descriptors: *Costs analysis, *Irrigation systems, *Agriculture, *Water conservation, Evaluation, Methodology, Energy, Pumping, Economics, Prices, *Bayesian decision theory.

The uncertainty of energy prices in the recent past suggests that farm managers must carefully consider risks in accessing the lifetime cost of alternative irrigation systems. The use of conventional decision theory augmented with Bayesian theory provides a way of examining both the traditional variability of energy prices and of updating this variability with information provided by most recent examples. The procedure is outlined in this report and an empirical application is used as an illustration of the methodology.
W80-06534

SELF-STEERING CROP IRRIGATOR,
H. Tidwell.
U.S. Patent No. 4,185,774, 5 p, 6 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 990, No 5, p 1654, January 29, 1980.

Descriptors: *Patents, *Irrigation systems, *Distribution systems, Application equipment, Irrigation efficiency, Irrigation practices, *Self-steering irrigator.

An irrigation boom of sufficient length to span a number of crop rows has multiple angularly adjustable dual valved water distributors along its length and is carried on a utility platform which mounts a self-contained power drive means for dual traction wheels of the irrigator and a hose reel which supplies water to the boom from a remote source. A forward guidance and stabilizer wheel follows small furrows produced by a furrow former ahead of such wheel and a trailing steering arm carries a shoe which follows in the small furrows rearwardly of the furrow former and rimmed guidance wheel. (Sinha-OEIS).
W80-06569

IRRIGATION SYSTEM SELECTION FOR MAXIMUM CROP PROFIT,
Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
R. W. Hill, and J. Keller.
Transactions of the American Society of Agricultural Engineers, Vol 23, No 2, p 366-372, March-April 1980. 8 Fig, 4 Tab, 8 Ref. AID/csd-2459.

Descriptors: *Irrigation, *Irrigation design, *Irrigation systems, *Model studies, Mathematical

models, Irrigation efficiency, Crops, Costs, Economics, Furrow irrigation, Sprinkler irrigation, Irrigation practices, Optimization, Computer models, Computer programs, Design.

The selection of irrigation systems and management of irrigation water to maximize profit from crop production implies an optimization process of some sort. Such an optimization of irrigation system design is a complicated task and most often it is done by intuition. It involves the physical system, crop growth patterns, crop response to water and fertility and on-farm management practices. This paper presented a methodology for relating the selection of irrigation system design parameters to the crop production profitability. Irrigation system uniformity along with the scheduling of applied water has an important effect on crop yield and thus net farm income. A computerized technique was used which related system uniformity and scheduling practices to crop growth and production. For a given irrigation system design, furrow, sprinkle, or trickle, and a particular scheduling scheme, the seasonal water application which will maximize the net profit from a specified crop can be estimated. (Sims-ISWS)
W80-06674

RUNOFF, EROSION, AND CROP YIELD SIMULATION FOR LAND USE MANAGEMENT,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 4A.
W80-06676

DISTRIBUTION PATTERNS OF HOME LAWN SPRINKLERS,
Wyoming Univ., Laramie. Dept. of Agricultural Engineering.
G. L. Kerr, L. O. Pochop, J. Borrelli, and D. A. Anderson.
Transactions of the American Society of Agricultural Engineers, Vol 23, No 2, p 387-392, March-April 1980. 1 Fig, 6 Tab, 8 Ref.

Descriptors: *Sprinkling, *Sprinkler irrigation, *Lawns, *Distribution patterns, Evaluation, Testing, Testing procedures, Equipment, Data processing, Statistics, Statistical methods, Irrigation, Irrigation efficiency, Irrigation practices, Home lawn sprinklers.

Distribution patterns of six typical lawn sprinkler types were determined during the summer of 1977. Tests were conducted on four sprinklers from each type under three pressure levels. Christiansen's Uniformity Coefficients (UCC) were calculated for the original pattern and for various overlaps of the sprinklers. Overlaps required to achieve minimum acceptable UCC values were then determined. The output of each sprinkler was measured and application rates were calculated for individual pattern sizes at the three pressure levels. Two important factors for effective lawn watering include: (1) use of the proper overlap for an individual sprinkler type, and (2) determining the application rate in order to apply the proper amount of water. (Sims-ISWS)
W80-06677

SIMULATION OF SOIL WATER AND SALT REGIMES DURING TRICKLE IRRIGATION,
Arizona Univ., Tucson.
A. W. Warrick, and D. O. Lomen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-103046, Price codes: A03 in paper copy, A01 in microfiche. Project Completion Report, July 1980. 38 p, 14 Fig, 4 Tab, 21 Ref. OWRT-B-064-ARIZ (4), 14-34-0001-8059.

Descriptors: *Soil water movement, *Irrigation water, *Mathematical models, Evaporation, Soil moisture, Plant growth, Root zone, Root systems, Row spacing, *Trickle irrigation, High frequency irrigation, Matrix flux potential.

Mathematical models for determining the moisture pattern resulting from various configurations occurring in trickle irrigation were developed. Particular emphasis was on the effect of water uptake by plant roots. Examples are given for one, two and three dimensional geometries. For one dimensional flow, a solution was developed which includes an evaporative type surface condition in addition to water uptake by plant roots. A newly developed solution for a cylindrical rooting volume allows fairly simple equations to describe single plant dynamics. Nomographs are included to allow easy application of the results without reproducing or utilizing lengthy mathematical expressions.
W80-06688

AUTOMATION OF PIVOT SPRINKLER IRRIGATION SYSTEMS TO MORE EFFICIENTLY UTILIZE RAINFALL AND IRRIGATION WATER,
Texas Water Resources Inst., College Station.
C. W. Wendt, J. R. Runkles, M. D. Gerst, H. P. Harbert, III, and R. B. Hutmacher.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-103319, Price codes: A05 in paper copy, A01 in microfiche. Research Project Completion Report, Technical Report No 107, August, 1980. 75 p, 24 Fig, 15 Tab, 45 Ref, 1 Append. OWRT-A-044-TEX (1), 14-34-0001-8046, 14-34-0001-9046.

Descriptors: *Irrigation systems, *Automation, *Sprinkler irrigation, Water control, Irrigation water, Irrigation efficiency, Wells, Water requirements, Sprinkling, Water utilization, Crops, Texas, Farms, Agriculture, Rainfall, Plant growth, Soil types, Evapotranspiration, Soil water tension, Soil-water-plant relationships, Water management(Applied), Pivot sprinkler, Earth(TX).

Development of automated pivot sprinkler irrigation systems was studied near Earth, Texas, using irrigation systems on producers farms. Evaluations undertook to determine whether such automated systems use less water/energy than manually-operated systems. Sensors with transmitters and receivers (separately or in combination) were constructed and tested to control the irrigation systems by wind, soil water tension, and rainfall. It was not possible to determine whether automated systems use less water/energy than manually-operated systems, principally due to the low capacity of the wells (114-204 cu m/hr) supplying the irrigation systems. The well capacity needs to be at least 284 cu m/hr for crop water requirements and losses due to evaporation/runoff. Low well water supply resulted in soil water tension out of the tensiometer range for the last 60 days of the growing season. Variations in soil water tension and content between irrigation systems and within irrigation system quadrants was considerable. Irrigation systems having lower crop water requirements (cotton) could probably be automated easier than corn. Wind/rainfall controls can increase water use efficiency more than soil water sensor controls, while wind controls during pre-irrigation could aid producers having remote irrigation systems. (Zielinski-IPA)
W80-06701

WATER SYSTEMS MANAGEMENT USERS GUIDE,
Water and Power Resources Service, Denver, CO. Engineering and Research Center.
J. F. Buchheim, L. F. Ploss, and L. A. Brower.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-220973, Price codes: A04 in paper copy, A01 in microfiche. Report No REC-ERC-80-3, April 1980. 86 p, 19 Fig, 4 Tab, 2 Append.

Descriptors: *Irrigation programs, *Water management, *Computer programs, *Water conservation, Irrigation, Farms, Crop production, Evapotranspiration, Agriculture, Computer models, Water requirements, Scheduling, Crops, Soil moisture, Data processing, Schedules, Soil types, *Irrigation systems users guide.

This Guide describes scheduling principles, application, and description and use of a computer-supported program (time irrigation management services (TIMS)) for improving project operations for effective utilization of irrigation water. The program integrates on-farm water management with water distribution system operations to gain overall water management at the irrigation project level. The TIMS computer program is simple to operate and can be used on smaller minicomputers. The procedure incorporates crop coefficients for various crops, based on the ratio of evapotranspiration (ET) rate of a specific crop to that for a reference crop (e.g., healthy alfalfa with 10-12 in. top growth). For the purpose of scheduling irrigations, a daily water budget analysis is made for each field using the daily ET rate, effective irrigation amounts, and precipitation date. This information is used to compute the daily soil moisture depletion (SMD). The optimum level of SMD is termed the allowable depletion, determined by projecting the crop ET rate in crop season time. Field irrigation scheduling provides the irrigator/farm manager with daily soil moisture status on each field, and gives the irrigator the optimum date and amount of the next irrigation. (Zielinski-IPA)
W80-06712

WATER ACCUMULATOR-DISTRIBUTOR FOR AGRICULTURAL SPRINKLER,
Toro Co., Riverside, CA. (Assignee).
E. J. Hunter.
U.S. Patent No 4,177,926, 9 p, 6 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 989, No 2, p 514, December 11, 1979.

Descriptors: *Patents, *Irrigation, *Sprinkler irrigation, *Distribution systems, Storage, Valves, Irrigation efficiency, Irrigation practices, Application equipment.

An accumulator-distributor gathers a quantity of water under pressure and rapidly discharges it in bursts so that large agricultural areas can be watered from a low volume source of irrigation water. An expandible chamber is provided having a flexible diaphragm as one wall. Bias means carried by the flexible diaphragm are adapted to exert a pressure upon the valve member closing the outlet opening from the chamber an amount insufficient to retract the valve against the differential pressure of the accumulated water. A second member is adapted to contact and lift the valve member from the valve seat at the point of maximum expansion of the chamber whereby the differential pressure is removed from the valve and the bias means is able to rapidly withdraw the valve member completely from the outlet opening from the chamber to allow the rapid and complete expulsion of the accumulated water in an optimal manner. (Sinha-OEIS)
W80-06806

SIDE WALKING IRRIGATION SYSTEM,
Miller Brothers Farms, Inc., Cordele, GA. (Assignee).
C. S. Miller.
U.S. Patent No 4,184,639, 7 p, 4 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 990, No 4, p 1278, January 22, 1980.

Descriptors: *Patents, *Irrigation, *Irrigation systems, *Lateral convenance structures, Application equipment, Irrigation efficiency, Irrigation practices, Prime mover wheeled towers.

A first steerable prime mover wheeled tower and a number of laterally spaced intermediate and end towers collectively carry a horizontal irrigation conduit which receives water through a hose dragged behind the prime mover wheeled tower. The irrigation conduit is supported by a truss structure extending between the tops of the several towers. Electric drive motors on the individual towers are powered in proper sequence to cause the intermediate and end wheeled towers to follow the linear path of the prime mover wheeled tower without appreciable lag. A system of control switches responds to tension in a control cable connected with a spring-loaded crank element on the prime mover wheeled tower to produce automatic activation of the control switches. (Sinha - OEIS)
W80-06810

OPTIMAL SEASONAL IRRIGATION APPLICATION ANALYSIS,
Wastequip, Inc., Davis, CA.
W. E. Hart, D. I. Norum, and G. Peri.
Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol 106, No IR3, Proceedings Paper 15687, p 221-235, September 1980. 4 Fig, 1 Tab, 26 Ref, 3 Append.

Descriptors: *Irrigation, *Optimization, *Model studies, Mathematical models, Infiltration, Percolation, Water table, Depth, Leaching, Nutrients, Crops, Rates of application, Costs, Seasonal, Distribution patterns, Soil water, Soil water movement, Water conservation, Irrigation water.

The concept of an optimal seasonal depth of infiltrated water for an irrigated crop was developed for the case when the yield is a quadratic function of the depth of water infiltrated and the water distribution function is known. The cost of drainage was taken into consideration for those situations when the infiltrated depth is large enough to cause reductions in yield or large enough to warrant installation of a drainage system because of water logging or drainage problems elsewhere. In addition, the cost of leached nutrients or penalties or both for excess deep percolation were considered. An example was used to show how to determine the optimal infiltrated depth when the yield function and water distribution function are known. It was also shown how one can determine how much additional capital can be spent to improve an irrigation system's uniformity in order to increase the profit. (Sims-ISWS)
W80-06827

ESTIMATING WATER USED BY IRRIGATED CORN IN WEST CENTRAL MINNESOTA,
Science and Education Administration, Morris, MN. North Central Soil Conservation Research Lab.
A. S. Dylla, D. R. Timmons, and H. Shull.
Soil Science Society of America Journal, Vol 44, No 4, p 823-827, July-August 1980. 5 Fig, 2 Tab, 10 Ref.

Descriptors: *Irrigation, *Evapotranspiration, *Corn(Field), *Minnesota, On-site investigations, Lysimeters, Measurement, Mathematical models, Estimating equations, Water requirements, Soil water, Soil moisture, Irrigation water, Evaporation, Agriculture, *Water utilization, Evapotranspiration estimation.

Irrigation development in Minnesota is expanding rapidly on the sandy and droughty soils of which there is considerable area. Construction of suitable wells into underlying gravel aquifers has facilitated the rapid growth. The objective of this study was to measure water use by irrigated corn in west central Minnesota for comparing with current estimating methods for irrigation scheduling. Lysimeters, 1.75 m diameter by 1.22 m deep, located in irrigated corn (Zea mays L.) plots were used to measure water use or evapotranspiration (ET) amounts. Four years of comparisons were made of measured ET to amounts calculated with the standard and refined Jensen-Haise potential ET equations and corn crop coefficients from southeastern North Dakota data. Measured ET was also compared with ET estimates determined by the Lundstrom-Stegman 'checkbook method,' and by crop coefficients with pan evaporation. Crop coefficients with pan evaporation provided the better ET estimates, however, the 'checkbook method' was the simplest and was about as accurate for estimating ET as the Jensen-Haise potential ET equation with southeastern North Dakota crop coefficients. (Sims-ISWS)
W80-06840

IRRIGATION SYSTEM,
G. R. Ferguson, and E. D. Freeman.
U.S. Patent No 4,186,763, 6 p, 5 Fig, 4 Ref; Official Gazette of the United States Patent Office, Vol 991, No 1, p 112, February 5, 1980.

Descriptors: *Patents, *Irrigation systems, *Irrigation efficiency, Water distribution(Applied), Water control, Hydraulic systems, Pipes.

The object of the invention is to facilitate the use of hydraulic fluid operated drives for circular irrigation systems. The conduit system which established fluid communication between the hydraulic fluid circulating device and a drive motor includes a rotary joint encircling the axis of rotation defined by the delivery pipe. The rotary joint conducts hydraulic fluid flow between the drive motor and the circulating pump during rotation of the distribution pipe of the irrigation system about the generally vertical water delivery pipe. (Sinha - OEIS)
W80-06939

PROGRAM CONTROL FOR CENTER POST IRRIGATION SYSTEM,
Colkhi, Inc., San Diego, CA. (Assignee).
E. F. Jacobi, and M. R. Madden.
U.S. Patent No 4,186,880, 9 p, 8 Fig, 4 Ref; Official Gazette of the United States Patent Office, Vol 991, No 1, p 155, February 5, 1980.

Descriptors: *Patents, *Irrigation systems, *Automatic control, Irrigation efficiency, Irrigation practices, Flow control, Electronic equipment.

The disclosure entails a program controlled multiloop system for providing even distribution of irrigating water over normally square plots. More specifically the system includes control loops connected to a center post irrigation system which control the advance rate, the flow rate, select an end gun nozzle, and select the elevation of the end gun under program control to provide even irrigation and full coverage of corners. (Sinha-OEIS)
W80-06940

IRRIGATION MACHINE,
Long Mfg. NC, Inc., Tarboro. (Assignee).
W. R. Long.
U.S. Patent No 4,186,881, 11 p, 12 Fig, 16 Ref; Official Gazette of the United States Patent Office, Vol 991, No 1, p 155, February 5, 1980.

Descriptors: *Patents, *Irrigation systems, *Application equipment, Irrigation efficiency, Irrigation practices, Water pressure, Hoses, Turbines.

The invention provides an irrigation machine of the type which includes a rotatable reel with a hose connected to a source of water under pressure. It has a travelling carriage connected to one end of the hose and also has a water drive turbine on the vehicle so that water passing through the hose drives the reel to coil the hose thereon and pull the travelling carriage toward the vehicle at a selected speed so that a large area of earth is irrigated. (Sinha-OEIS)
W80-06941

APPARATUS FOR WATERING AND DRAINING SOIL,
Cellsystem AG, Oftringen (Switzerland). (Assignee).
J. P. Izatt.
U.S. Patent No 4,188,154, 8 p, 4 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 991, No 2, p 578, February 12, 1980.

Descriptors: *Patents, *Irrigation, *Subsurface irrigation, *Irrigation practices, *Drainage, Irrigation efficiency, Soil-water-plant relationships, Application equipment.

The invention provides an apparatus which, when used for irrigation or watering, provides for entry of water into the adjacent soil in a trickle of sufficiently low pressure not to cause washing away or shifting of portions of the soil, but which is nevertheless capable of being employed for drainage or dewatering without the need for any adjustment or modification. An inner small-diameter duct is secured eccentrically inside an outer large-diameter duct with the walls of the ducts closely adjacent to one another along their tops. Ports through the wall of the inner duct provide a sump in its bottom and are spaced below its top to provide an air chamber above the sump. The outer duct also has ports providing a shallow sump in the bottom of the outer duct and an air chamber above. During irrigation, water falls from the inner duct to the sump in the outer duct, then flows out through the outer duct ports. For drainage, water rises in the outer duct to the level of the ports in the inner duct, while slime and sediment remain in the sump in the outer duct. (Sinha-OEIS)
W80-06942

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

UNDERDRAINAGE PIPE,
Mitsui Petrochemical Industries Ltd., Tokyo (Japan). (Assignee).
S. Hieda, Y. Uehara, and M. Inaba.
U.S. Patent No 4,182,580, 6 p, 11 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 990, No 2, p 587, January 8, 1980.

Descriptors: *Patents, *Drainage systems, *Subsurface drainage, Water control, Pipes, Drainage practices.

The underdrainage pipe may be buried in the ground for facilitating drainage at agricultural fields, lands for housing, damp grounds, playing fields, and tennis courts. It can withstand various pressure and weight because the recess has a raised portion. Therefore, a thin pipe wall can be employed making manufacturing easy and cost low. The pipe comprises a liquid-collecting pipe, protrusions on the liquid-collecting pipe, a filter layer around the liquid-collecting pipe and a liquid-conducting way. The protrusions have at least one recess and the bottom portion of the recess does not reach the surface of the liquid-collecting pipe. (Sinha - OEIS)
W80-06463

PIPE FOR UNDERDRAINING,
Mitsui Petrochemical Industries Ltd., Tokyo (Japan). (Assignee).
Y. Uehara, M. Inaba, N. Ishii, and Y. Kusumi.
U.S. Patent No 4,182,581, 8 p, 15 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 990, No 2, p 587, January 8, 1980.

Descriptors: *Patents, *Drainage systems, *Subsurface drainage, Water control, Filtration, Pipes, Drainage practices.

A pipe for underdrainage comprises (1) a liquid-collecting pipe; (2) a number of discontinuous protrusions on the outer surface of the pipe; (3) a filter layer capable of passing liquid while substantially excluding solids, the filter layer being placed around the pipe and contacting the top portions of the protrusions; and (4) a liquid-conducting way composed of a space communicating both in the longitudinal direction and in the peripheral direction of the pipe and its protrusions and the inner surface of the filter layer. (Sinha - OEIS)
W80-06464

FOREST MANAGEMENT EFFECTS ON INTERCEPTION, EVAPORATION, AND WATER YIELD,
Forest Research Inst., Christchurch (New Zealand).
For primary bibliographic entry see Field 2D.
W80-06476

URBANIZATION EFFECTS AND THE CONTROL OF THE SURFACE RUNOFF PROCESS IN SMALL WATERSHEDS,
South Dakota School of Mines and Technology, Rapid City.
T. P. Propson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-222813, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Institute, South Dakota State University, Brookings, Completion Report, June

1980. 69 p, 6 Fig, 3 Tab, 18 Ref, 4 Append. OWRT-B-034-SDAK (1), 14-34-0001-3842.

Descriptors: *Urban runoff, *Model studies, *Small watersheds, *Flood plain zoning, Urbanization, Unit hydrographs, Storm sewers, Environment, Greenway approach, *Flow control, Surface runoff, Evaluation, *Rapid City(SD).

An approach to the solution of urban runoff problems that has gradually evolved and gained in popularity during the past few years is the 'greenway' or 'greenbelt' approach. To facilitate the determination of the flood-plain zone (the greenway) for small watersheds, a new urban runoff model, the Rapid City Runoff Model (RCRM) has been developed which, while lacking the broad flexibility of the more sophisticated models, is less wasteful in terms of computer storage, compilation time, and cost of data preparation. We believe that RCRM is an urban runoff simulation model which provides for a greater level of hydraulic accuracy than the less sophisticated models while remaining at a level of sophistication compatible with established practice, and with minimum data collection and preparation time. This model is based upon urban hydrology principals developed by the Soil Conservation Service and has been refined to include: (1) up to 63 subbasins within a major drainage basin; (2) a sophisticated technique for identification of each subbasin which establishes the drainage pattern of the main basin; (3) a more realistic and accurate method of modeling the hydrologic characteristics of natural drainage channels; and (4) the capability to predict the extent of lateral inundation produced by the design peak discharges. W80-06558

GEOHYDROLOGIC SETTING OF AND SEEPAGE FROM A WATER-SUPPLY CANAL, INDIANAPOLIS, MARION COUNTY, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
W. Meyer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-176555, Price codes: A02 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 79-115, November 1979. 16 p, 7 Fig, 1 Tab, 6 Ref.

Descriptors: *Canal seepage, *Hydrogeology, *Water supply, *Indiana, Water levels, Groundwater recharge, Discharge(Water), Discharge measurement, Observation wells, Water temperature, *Marion County(IN).

The Indianapolis Water Company Canal is underlain by alluvial and outwash deposits. The water level in the canal on July 21, 1978, was above the water table along the entire reach of the canal upstream from the Fall Creek aqueduct, and, therefore, water was seeping downward from the canal into these deposits along this entire reach. Because of the highly variable lithology of the deposits underlying the canal, the seepage rate was probably also highly variable. Discharge measurements were made at selected points along the canal, and differences between successive measurements were calculated to determine the rate of water loss. The differences were smaller than the potential error in any of the measurements, however, and thus do not directly substantiate that water is being lost. The rate of water loss over the Fall Creek aqueduct by the skimming process could be as high as 43 cubic feet per second, assuming a 5% potential error for discharge measurements made at both ends of the aqueduct. Lower stages and water temperatures would decrease the rate of water loss. Observed ground-water levels were above the canal bottom at three locations along the canal. Lowering these levels below the bottom would increase seepage by approximately 9 cubic feet per second. (USGS)
W80-06586

PROBLEMS OF RATIONALLY DRAINING THE POLEYES MARSHES,
Akademiya Navuk BSSR, Minsk. Inst. of Experimental Botany.
Y. G. Petrov.
Ground Water, Vol 18, No 4, p 351-358, July-August 1980. 3 Fig, 2 Tab, 7 Ref.

Descriptors: *Marshes, *Drainage, *Drainage effects, Water levels, Groundwater, Soils, Root zone, Vegetation, Land reclamation, Peat, Organic matter, Soil properties, On-site investigations, *USSR.

Comprehensive, steady-state investigations were carried out on plots adjoining drained tracts in Byelorussia's southern marshified lowlands, plots encompassing different plant cover, types of soil and groundwater levels, to ascertain the influence of groundwater level and its fluctuations on the formulation and productiveness of forest, field and meadow verdure. It was established that when the groundwater level diverges--higher or lower--from optimum (i.e., depth approximately equal to the height of the capillary lift), productiveness of plants fell; that intensive utilization and drying of peat bog soils leads, as a rule, to mineralization of the peat, air and water erosion (the lower the level falls the more intensively mineralization proceeds). It was calculated that with cultivated crops the loss of peat was some 10 tons per hectare per year, 5-6 with cereals and 2-3 with grasses. Lowering the groundwater level on any area leads to changed levels on adjacent areas, the groundwaters being elements of a unified system. In the sandy soils most widespread in the Byelorussian lowlands, lowering of groundwater level perceptible in the vital activities of plants occurs up to 2 kilometers from the drained tract. In all cases, reductions in groundwater level and in the duration and height of flooding leads to degradation of the meadows. It was concluded that comprehensive calculations on the possible harmful effects of drainage reclamation-caused changes in a large territory's hydrological regime are a prerequisite for rational utilization of the land and maximum productiveness and preservation of the natural landscape. (Sims-ISWS)
W80-06600

DETERMINING OPERATING POLICIES FOR A WATER RESOURCE SYSTEM,
Birmingham Univ. (England). Dept. of Engineering Production.
C. H. Dagli, and J. F. Miles.
Journal of Hydrology, Vol 47, No 3/4, p 297-306, July 1980. 3 Fig, 1 Tab, 14 Ref.

Descriptors: *Reservoirs, *Reservoir operation, *Water management(Applied), *Model studies, Mathematical models, Planning, Dams, Powerplants, Irrigation, Rivers, Tributaries, Lakes, Storage, Storage capacity, Water levels, Flow, Hydrology, Water resources, *Turkey, *Firat River(Turkey).

The object of the study described in this paper was to find a method of determining operating policies for a set of four dams which are to be constructed on the Firat (Euphrates) River in Turkey. Each of the dams has an associated hydro-electric powerplant, and there are requirements to supply water for irrigation, as well as maintaining river flows downstream of the dams into Syria and Iraq. The problem is complex and conventional stochastic models would entail an excessive amount of computation. Moreover, the set of feasible operating policies is so large that simulation cannot be considered a viable alternative. The method adopted was described as adaptive planning (AP). At time t a forecast is made of the inflow values expected during the planning period and using these forecast values a deterministic model of the system is solved to obtain an operating policy for time t + 1. The forecast is updated and the model re-run at each successive time period to yield revised policies based on the latest available data. The solution obtained by this method for a five-year test period, using historical data, was within 0.4% of the optimal solution. (Sims-ISWS)
W80-06628

DRAINAGE REQUIREMENTS FOR LAND APPLICATION WASTEWATER TREATMENT,
Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 5E.
W80-06670

RUNOFF, EROSION, AND CROP YIELD SIMULATION FOR LAND USE MANAGEMENT,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
D. G. DeCoursey.
Transactions of the American Society of Agricultural Engineers, Vol 23, No 2, p 379-386, March-April 1980. 9 Fig, 10 Tab, 11 Ref.

Descriptors: *Runoff, *Erosion, *Crops, *Land use, *Model studies, Mathematical models, Cotton, Farm management, Watersheds(Basins), Fertilizers, Sediments, Slopes, Agricultural watersheds, Hydrology.

This paper described a system for combining hydrology, infiltration, moisture redistribution, crop growth, and rill-interrill erosion models. Data from a cotton field in the Mississippi Delta were used to test and refine the system. Examples were presented showing how the system can be used to evaluate alternative land-management schemes. The model showed that row spacing, land slope, and tillage operations affect runoff and sediment yields more than do factors such as plant population and fertilizer application rates. It also showed the responsiveness of cotton yields to changes in plant density, fertilizer application rates, and row spacing. (Sims-ISWS)
W80-06676

HYDROLOGIC DATA COLLECTED AT CLOSURE OF GAINESVILLE LOCK AND DAM, TOMBIGBEE RIVER NEAR GAINESVILLE, ALABAMA,
Geological Survey, Tuscaloosa, AL. Water Resources Div.
E. G. Ming, and F. C. Sedberry.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $4.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 8-348, November 1979. 33 p, 11 Fig, 13 Tab, 1 Ref.

Descriptors: *Streamflow, *Locks, *Dams, Projects, *Alabama, Data collections, Reservoirs, Groundwater, Water levels, Gaging stations, Water quality, Chemical analysis, *Gainesville Lock and Dam(AL), *Tombigbee River(AL), Engineering structures, Hydrologic effects.

The Gainesville Lock and Dam is the first of ten lock and dam projects on the Tennessee-Tombigbee Waterway to be completed. The structure was completed in 1978 and filling of the reservoir commenced March 20, 1978, resulting in changes in stream stage and discharge, ground-water levels, and chemical quality of the water. Data showing those changes are listed. (USGS)
W80-06793

TWO-DIMENSIONAL FINITE ELEMENT ANALYSIS OF THE HYDRAULIC EFFECT OF HIGHWAY BRIDGE FILLS IN A COMPLEX FLOOD PLAIN,
Geological Survey, NSTL Station, MS. Gulf Coast Hydroscience Center.
For primary bibliographic entry see Field 2E.
W80-06921

4B. Groundwater Management

ORGANIC WATER QUALITY CHANGES DURING SAND BANK AND DUNE FILTRATION OF SURFACE WATERS IN THE NETHERLANDS,
Rijksinstituut voor Drinkwatervoor-ziening, Leidschendam (Netherlands).
G. J. Piet, and B. C. J. Zoeteman.
American Water Works Association Journal, Vol 72, No 7, p 400-404, July 1980. 1 Fig, 8 Tab, 8 Ref.

Descriptors: *Water quality, *Surface waters, *Infiltration, *Soil contamination, *Artificial recharge, Recharge, Water pollution, Organic compounds, Groundwater, Halogens, Chlorinated hydrocarbon pesticides, Nitrogen compounds, Water

pollution sources, Soil contamination effects, Odor, Taste, Filtration, *Sand bank filtration, *Dune filtration.

Artificial recharge of polluted water began years ago in The Netherlands before any data concerning the behavior of organic chemicals in the soil were available. The current application of advanced analytical techniques is shedding new light on the potential of infiltration processes to remove chemical compounds from polluted raw waters and on the possible dangers of soil contamination in the recharge area. With these new insights, the reactions of organic chemicals--organic halogen compounds, organic nitrogen compounds, and odor-producing compounds--during the passage of water through the soil have gained not only a scientific but also a political impact. (Preece-ISWS)
W80-06494

WATER REUSE FOR GROUNDWATER RECHARGE: AN OVERVIEW,
Stanford Univ., CA. Dept. of Civil Engineering.
P. V. Roberts.
American Water Works Association Journal, Vol 72, No 7, p 375-379, July 1980. 1 Ref.

Descriptors: *Water reuse, *Groundwater recharge, *Artificial recharge, Groundwater, Recharge, Water resources, Aquifers, Reclamation, Public health, Water quality, Water quality standards, Percolation, Conferences, Water pollution, Organic wastes, Biodegradation, Injection, Infiltration, Riverbank filtration, Sand dune filtration.

Using reclaimed water to artificially recharge groundwater aquifers is one of the more promising approaches to replenishing dwindling water resources in water-short areas. When this reclaimed water will be used for domestic consumption, however, many questions arise that range from the health effects to the appropriate water quality standards for the points of recharge and extraction to the available alternative methods of water reclamation technology. This summary reports the progress made toward defining and answering these questions. (Preece-ISWS)
W80-06495

GROUND-WATER SURFACE-WATER CONFLICTS,
Resource Consultants, Inc., Fort Collins, CO.
For primary bibliographic entry see Field 6E.
W80-06504

DIGITAL-MODEL PROJECTION OF SATURATED THICKNESS AND RECOVERABLE WATER IN THE OGALLALA AQUIFER, TEXAS COUNTY, OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 2F.
W80-06521

PRELIMINARY DATA DESCRIBING THE DISTRIBUTION OF FLUORIDE AND SILICA IN THE OGALLALA AQUIFER ON THE HIGH PLAINS OF TEXAS,
Geological Survey, Denver, CO. Water Resources Div.
R. L. Bassett, S. G. Perkins, and R. K. Waddell.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $14.50 in paper copy, $3.50 in microfiche. Geological Survey open-file report 80-349, 1980. 109 p, 8 Fig, 2 Tab, 17 Ref.

Descriptors: *Fluorides, *Silica, *Aquifer characteristics, *Geochemistry, *Texas, Artifical recharge, Hydrogeology, Analytical techniques, Epidemiology, Groundwater, Water quality, Water chemistry, *Ogallala aquifer(TX), *High Plains(TX).

The Ogallala aquifer of Texas historically has been known for elevated fluoride concentration, with many areas in excess of 4 milligrams per liter. In addition, on a regional scale, silica concentrations are also somewhat elevated, with concentrations averaging in the 40 to 50 milligrams per liter range. This aquifer provides a unique geochemical and epidemiological study area because it is completely contained within the High Plains physiographic province. (USGS)
W80-06577

AVAILABILITY OF GROUND WATER FOR IRRIGATION ON THE KEKAHA-MANA COASTAL PLAIN, ISLAND OF KAUAI, HAWAII,
Geological Survey, Menlo Park, CA. Water Resources Div.
R. J. Burt.
Hawaii Division of Water and Land Development Report R53 (Revised), September 1979. 50 p, 14 Fig, 4 Tab, 13 Ref.

Descriptors: *Groundwater resources, *Irrigation, *Sugarcane, *Hawaii, *Hydrologic data, Hydrogeology, Irrigation wells, Aquifer characteristics, Withdrawal, Water yield, Artesian heads, Drawdown, Saline water intrusion, Sea water, Groundwater recharge, Evaluation, *Kauai(HI).

The Kekaha-Mana coastal plain on the southwest side of the island of Kauai, Hawaii, is underlain by a basaltic aquifer from which individual large-diameter wells or shafts yield as much as 22 million gallons per day (Mgal/d). Present supplies are from shafts on the inland edge of the plain. The basaltic aquifer is recharged in a highland area adjacent to the plain and is overlain by about 200 feet of poorly permeable sediments that retard natural discharge, creating artesian conditions. Pumpage from wells and shafts tapping the basaltic aquifer for irrigation of sugarcane began in the early 1900's. This development of ground-water supplies has been accompanied by an increasing chloride content of water from the basalt, reflecting seawater intrusion as artesian heads declined. Average pumpage for 1958-68 was about 24 Mgal/d (27,000 acre-feet annually); average pumpage for 1969-73 was about 42 Mgal/d (47,000 acre-ft annually), nearly doubling the former average. However, during the succeeding 5-year period, 1974-78, annual pumpage dropped to about 30 Mgal/d. Hydrologic budget figures indicate that at this rate pumpage is equivalent to recharge. The central management concern is maintaining long-term maximum productivity of the aquifer while controlling the intrusion of salty water. (USGS)
W80-06587

GROUND-WATER RESOURCES OF MORTON COUNTY, NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
D. J. Ackerman.
North Dakota County Ground-Water Studies 27--Part III, and North Dakota Geological Survey Bulletin 72-Part III, 1980. 51 p, 10 Fig, 3 Plates, 1 Tab, 37 Ref.

Descriptors: *Groundwater resources, *North Dakota, *Water quality, *Aquifer characteristics, *Water yield, Water wells, Water level fluctuations, Water utilization, Groundwater availability, Water supply, Chemical properties, Maps, Hydrographs, *Morton County(ND).

A study of the occurrence and characteristics of aquifers and the movement, quantity, and quality of water in aquifers in Morton County found that aquifers in the glacial drift and alluvium underlie only 10 percent of the county but have the greatest potential for large-scale development. These aquifers, composed of sand and gravel, occur in buried valleys and in major river valleys. In some localities yields may exceed 500 gallons per minute of water suitable for irrigation; however, where a hydraulic connection exists between bedrock and glacial-drift aquifers, large withdrawals of water from the glacial-drift aquifer will result in increased dissolved solids and percent sodium. Bedrock aquifers, consisting of very fine to fine-grained sandstones, yield less than 100 gallons per minute of water that is generally soft, moderately saline, and useful for domestic, livestock, and some industrial uses. The Fox Hills aquifer underlies all the county and is the most extensive and continuous bedrock aquifer. It is exposed in the southeastern corner of the county and lies at a depth of more than 1,500 feet in the northwestern corner of the county. Bedrock aquifers above the Fox Hills occur in the Hell Creek, Ludlow and Cannonball Formations undifferentiated, Tongue River, and Sentinel Butte Formations. (USGS)
W80-06590

GROUND WATER RESOURCES OF RAMSEY COUNTY, NORTH DAKOTA,
Geological Survey, Billings, MT. Water Resources Div.; and Geological Survey, Bismarck, ND. Water Resources Div.
R. D. Hutchison, and R. L. Klausing.
North Dakota County Ground-Water Studies 26--Part III, and North Dakota Geological Survey Bulletin 71-Part III, 1980. 36 p, 11 Fig, 1 Plate, 3 Tab, 39 Ref.

Descriptors: *Groundwater resources, *North Dakota, *Water quality, *Aquifer characteristics, *Water yield, Water wells, Water level fluctuations, Water utilization, Groundwater availability, Water supply, Chemical properties, Maps, Hydrographs, Ramsey County(ND).

The quantity, quality, and movement of ground water in Ramsey County was determined by an evaluation of existing hydrologic data and data acquired through a program of test drilling and observation-well development. Ground water is obtainable from sand and gravel deposits in the glacial drift, from fractured shale in the upper 50 to 200 feet of the Pierre Formation, and from sand and (or) sandstone beds in the Dakota Group. The major glacial-drift aquifers are the Spiritwood aquifer system and the Starkweather aquifer. The Spiritwood aquifer system underlies an area of 152 square miles in southern and western Ramsey County. Properly constructed wells developed in the thicker parts of the aquifer system yield from 500 to 1,000 gallons per minute of water containing 432 to 2,430 milligrams per liter dissolved solids. The Starkweather aquifer underlies an area of 13 square miles in central Ramsey County. Well yields generally range from 50 to 250 gallons per minute; however, yields of as much as 500 gallons per minute may be possible. Dissolved-solids concentrations range from 623 to 2,490 milligrams per liter. Wells in Pierre aquifer yield as much as 10 gallons per minute to water containing 330 to 9,800 milligrams per liter dissolved solids. Maximum reported well yield from the Dakota aquifer is 280 gallons per minute. Dissolved-solids concentrations were 3,770 and 3,870 milligrams per liter. (USGS)
W80-06591

GROUND-WATER DATA FOR SHERIDAN COUNTY, NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
M. R. Burkart.
North Dakota County Ground-Water Studies 32--Part II, and North Dakota Geological Survey Bulletin 75--Part II, 1980. 302 p, 2 Fig, 1 Plate, 4 Tab, 21 Ref.

Descriptors: *Groundwater, *Basic data collections, *North Dakota, *Aquifer characteristics, *Water quality, Water supply, Groundwater availability, Hydrogeology, Water wells, Groundwater recharge, Well data, Water yield, Potential water supply, Observation wells, Water levels, Water users, Chemical analysis, *Sheridan County(ND).

The purpose of the investigation in Sheridan County, ND, was to determine the availability and quality of ground water for municipal, domestic, industrial, and irrigation uses. Specifically, the objectives were to: (1) determine the location, extent, and nature of the major aquifers; (2) evaluate the occurrence and movement of ground water, including the sources of recharge and discharge; (3) estimate the quantities of water stored in the aquifers; (4) estimate the potential yields of wells tapping the major aquifers; (5) evaluate the chemical quality of the ground water; and (6) estimate the water use. The data in this report were collected between 1976 and 1979. The data consist of the following; (1) Geologic and hydrologic records for 320 wells and test holes; (2) water-level meas-

urements in 61 observation wells; (3) lithologic and geophysical logs of 308 test holes and wells; and (4) chemical analyses of 93 ground-water samples. (USGS)
W80-06592

WESTMINSTER QUADRANGLE: GEOLOGY, HYDROLOGY, AND MINERAL RESOURCES,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W80-06597

WINFIELD QUADRANGLE: GEOLOGY, HYDROLOGY, AND MINERAL RESOURCES,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W80-06598

NEW WINDSOR QUADRANGLE, MARYLAND: GEOLOGY, HYDROLOGY, AND MINERAL RESOURCES,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W80-06599

GROUND WATER AND ENERGY, REPORT OF THE U.S. DEPARTMENT OF ENERGY'S NATIONAL WORKSHOP, ALBUQUERQUE, NM, JANUARY 29-31, 1980.
Department of Energy, Office of Technology Impacts, Washington, D.C., May, 1980. 21 p, 2 Fig, 2 Append.

Descriptors: *Groundwater, *Energy, *Water supply, *Water demand, Water utilization, Groundwater availability, Environmental effects, Regulation, Constraints, Legal aspects, Political aspects, Management, Dewatering, Saline water, Deep water, Aquifers, Administration, Information exchange, Legislation.

A summary of the findings of the January 29-31, 1980, National Workshop on Ground Water and Energy in Albuquerque, NM, is given in this report. The U.S. Department of Energy's Office of Technology Impacts sponsored the workshop and the central issues which were addressed in the working groups included supply, conflicts and barriers, and alternatives. An increase in energy production in the U.S. will increase the demand for general water supplies. These demands will probably be met nationally, but some local shortages of surface water will exist. The shortages can be met by tapping groundwater resources if an aquifer is available and if the community accepts the withdrawal. Groundwater development will require more efficient methods of analyzing, assessing, characterizing, managing, and sharing groundwater information than presently exists. The environmental effects of groundwater use for energy are not known. The use of saline groundwater, deep groundwater, and dewatering of mines may provide alternative sources. The decision-making process is complicated by the variability of legal rules governing groundwater and the lack of uniform practices, goals, policies, and interests. The Department of Energy must play a major role in the establishment and dissemination of water policies. (Sidney-IPA)
W80-06713

MAPS SHOWING HYDROLOGIC CONDITIONS IN THE SAN FRANCISCO RIVER AREA, GREENLEE COUNTY, ARIZONA, 1978--A RECONNAISSANCE STUDY,
Geological Survey, Tuscon, AZ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W80-06796

ANNUAL SUMMARY OF GROUND-WATER CONDITIONS IN ARIZONA, SPRING 1978 TO SPRING 1979.
Geological Survey, Tuscon, AZ. Water Resources Div.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $10.75 in paper copy, $1.50 in microfiche. Geological Survey Open-File Report 80-330 (WRI), February 1980. 2 Sheets, 20 Ref.

Descriptors: *Arizona, *Groundwater, *Maps, *Water levels, *Pumping, *Drawdown, Irrigation, Water yield, Groundwater availability, Water supply.

In 1978 the withdrawal of ground water was about 4.2 million acre-feet in Arizona, and slightly more than 3.4 million acre-feet of ground water was used for the irrigation of crops. The amount of ground water withdrawn in 1978 decreased more than 1.2 million acre-feet from the amount withdrawn in 1977 and is the smallest amount withdrawn since the mid-1950's except in 1966. Nearly all the decrease was in the amount of ground water used for irrigation in the Basin and Range lowlands province. Possible causes for the decrease include above-average precipitation, greater availability of surface water, and some comparatively new conservation practices. The Salt River Valley and the lower Santa Cruz area are the largest agricultural areas in the State; the amount of ground water withdrawn for agricultural use in the Salt River Valley and the lower Santa Cruz area decreased nearly 613,000 and 291,000 acre-feet, respectively, between 1977 and 1978. The report contains two small-scale maps of Arizona that show (1) pumpage of ground water by areas and (2) the status of the ground-water inventory in the State. The main map, which is at a scale of 1:500,000, shows potential well production, depth to water in selected wells in spring 1979, and change in water level in selected wells from 1974 to 1979. The brief text that accompanies the maps summarizes the current ground-water conditions in the State. (USGS)
W80-06797

HYDROLOGIC AND WATER-QUALITY APPRAISAL OF SOUTHEAST NASSAU COUNTY, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 5B.
W80-06805

4C. Effects On Water Of Man's Non-Water Activities

URBANIZATION EFFECTS AND THE CONTROL OF THE SURFACE RUNOFF PROCESS IN SMALL WATERSHEDS,
South Dakota School of Mines and Technology, Rapid City.
For primary bibliographic entry see Field 4A.
W80-06558

URBAN RUNOFF: WHAT MAKES CITY STREAMS SICK.
Tennessee Valley Authority, Chattanooga. Office of Natural Resources.
Impact, Vol 3, No 4, p 11-13, July 1980, Runker, D., Ed., 3 Fig.

Descriptors: *Urban runoff, *Water pollution sources, *Path of pollutants, *Urbanization, Flow, Overland flow, Rainfall, Soil erosion, Urban drainage, Drainage systems, Storm water, Streams, Streamflow, Storm runoff, Surface waters, Chemical wastes, Pesticide residue, Eutrophication, Mountains, Tennessee, Evaluation, Agricultural chemicals, Knoxville(TN).

The problem of urban runoff is presently being investigated in a 3-year project focusing on Second Creek which drains the central business district and a large residential area in Knoxville, TN. It is hoped that the causes and possible cures for urban runoff will be derived from this study. Runoff has been a problem since antiquity, but today we have increased its impact by extensive urbanization, pollution, and unchecked soil erosion. Increased runoff has also increased washoff and soil and nutrients deposited in creeks and rivers as seen in the water in Second Creek which is highly eutrophic. The condition of Second Creek probably will not improve by the 1982 International Energy Exposition in Knoxville and this may become a source of embarrassment. As in most runoff situations, the determination of the sources and amount of pollution comprising diffuse nonpoint-sources is extremely difficult. The Second Creek project is the only study being conducted in a complex geological formation characteristic of the Appalachian and Cumberland Mountains. The project began July 1, 1980 with $750,000 in funding from EPA, $207,000 from TVA, and $43,000 from combined local funds and services in kind. (Sidney-IPA)
W80-06642

BUILDUP, STRENGTH, AND WASHOFF OF URBAN POLLUTANTS,
Illinois State Water Survey, Urbana.
For primary bibliographic entry see Field 5B.
W80-06758

STORMWATER QUALITY--FIRST EFFORTS IN DENVER,
Urban Drainage and Flood Control District, Denver, CO.
For primary bibliographic entry see Field 5B.
W80-06759

URBAN RUNOFF QUALITY: INFORMATION NEEDS,
Sonnen (M.B.) Co., Inc., Walnut Creek, CA.
For primary bibliographic entry see Field 5B.
W80-06760

URBAN RUNOFF MANAGEMENT: FUTURE MODELING,
Environmental Protection Agency, Washington, DC. Science Advisory Board.
H. C. Torno.
Journal of the Technical Councils of the American Society of Civil Engineers, Vol 106, No TC1, Proceedings Paper 15626, p 165-169, August 1980. 1 Fig, 12 Ref, 1 Append.

Descriptors: *Urban runoff, *Mathematical models, *Model studies, Reviews, Computer models, Drainage, Runoff, Sewers, Cities, Water quality, Forecasting, Hydrology, *Urban runoff management.

Several recent studies have demonstrated that computer-based mathematical models are becoming a standard part of the engineer's arsenal of tools for analyzing and designing urban drainage systems, and for evaluating the impacts of runoff-generated pollution and the remedial measures therefore. It is equally clear that while the catalog of available models is quite large, only a few are in common use. Future model use will emphasize applications. New model development will proceed at a slower pace until an adequate data base is available. Receiving water quality models will receive increased use. The use of mini/micro-computers will increase rapidly, and models will be adapted for use with low cost hardware. (Sims-ISWS)
W80-06834

4D. Watershed Protection

FOREST MANAGEMENT EFFECTS ON INTERCEPTION, EVAPORATION, AND WATER YIELD,
Forest Research Inst., Christchurch (New Zealand).
For primary bibliographic entry see Field 2D.
W80-06476

THE STREAMBANK EROSION CONTROL EVALUATION AND DEMONSTRATION ACT OF 1974: INTERIM REPORT TO CONGRESS.
Army Engineer Waterways Experiment Station, Vicksburg, MS.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A073673,

Price codes: A07 in paper copy, A01 in microfiche. September 1978. 278 p, 25 Ph, 119 Fig, 9 Append.

Descriptors: *Erosion control, *Bank protection, *Bank erosion, *United States, Streambanks, Bank stabilization, Programs, Evaluation, Progress report, *Streambank Erosion Control Evaluation and Demonstration Act 1974.

An interim status report on a program being conducted by the U.S. Army Corps of Engineers to develop low-cost-effective streambank protection guidelines for both public works and private citizens. Report covers programs involving the evaluation of extent of streambank erosion nationwide, a literature survey and evaluation of bank protection methods, hydraulic research on effectiveness of bank protection methods, research on soil stability and identification of causes of streambank erosion, demonstration of projects on streams nationwide, and specific demonstration projects on the Ohio, Missouri, and Yazoo Rivers. (WES)
W80-06536

EVALUATION OF SPRAY-ON STABILIZERS FOR BANK PROTECTION,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
J. C. Oldham.
Section 32 Program Streambank Erosion Control Evaluation and Demonstration Work Unit 4-Research on Soil Stability and Identification of Causes of Streambank Erosion, Investigation Report 1, February 1979. 32 p, 23 Fig, 2 Tab, 1 Append.

Descriptors: *Bank protection, *Bank stabilization, Erosion, *Erosion control, Banks, Testing, Vegetation establishment, Stabilizers, *Spray-on bank stabilizer.

Examines five spray-on type stabilizers to determine if they can control erosion on denuded streambanks without having an adverse effect on the re-establishment of vegetation. Materials used were Aerospray 70, Soil Seal, DLR, Peneprime, and Nerozin. Test plots using these materials were constructed on flat and sloping areas. These plots were monitored from 24 April to 22 June 1978. During this monitoring period, climatic data were collected using an automated field station with a digital recorder. In addition to the data collected by the field station, visual inspections were made daily and photos were taken periodically. Two of the materials tested, Aerospray 70 and Soil Seal, proved effective in aiding vegetation to be established on denuded slopes. (WES)
W80-06537

THE DESIGN OF SEDIMENT BASINS,
Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
A. D. Ward, C. T. Haan, and B. J. Barfield.
Transactions of the American Society of Agricultural Engineers, Vol 23, No 2, p 351-356, March-April 1980. 4 Fig, 2 Tab, 22 Ref.

Descriptors: *Sediment control, *Sediment yield, *Ponds, *Mining, *Model studies, Mathematical models, Design, Sediments, Particle size, Sediment load, Trap efficiency, Watersheds(Basins), Hydrology, Sedimentology, Sediment basins.

Passage of Public Law 95-87 placed several new restrictions on the design of surface mine sediment basins. It created much controversy as to the required sizing of the sediment basins, and adequate design methods are not available for estimating basin performance and effluent sediment concentrations. This paper presents guidelines as to how the hydrologic parameters affecting sediment basin design may be qualified and contains predictive equations for estimating basin trap efficiency and peak effluent sediment concentrations. (Sims-ISWS)
W80-06671

SEA RESEARCH PROGRAM FOR CHANNEL STABILITY AND GULLY CONTROL,
Science and Education Administration, Oxford, MS.
W. C. Little, R. F. Piest, and A. R. Robinson.
Transactions of the American Society of Agricultural Engineers, Vol 23, No 2, p 362-365, March-April 1980. 13 Ref.

Descriptors: *Gullies, *Bank stability, *Channels, *Erosion control, *Research and development, Erosion, Drainage, Runoff, Bank stabilization, Bank erosion, Channel erosion, Gully erosion, Projects, Research facilities, Research programs, Research effort, Research approaches, Science and Education Administration(SEA).

The USDA, Science and Education Administration, Agricultural Research, conducts National Research Programs to maintain and preserve natural resources and to ensure an adequate supply of food and fiber. The research program on erosion and sedimentation has several technological objectives, one of which is to stabilize channels and control gullies. This research has been carried on for many years at several locations, and past and present programs were discussed. Channel stability and gully problems and solutions were reviewed, and present research programs and future research approaches and plans were described. (Sims-ISWS)
W80-06673

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

LASER-PHOTOACOUSTIC DETECTION OF WATER POLLUTANTS; PHASE I,
Arkansas Univ., Fayetteville. Dept. of Physics.
G. J. Salamo, B. Chuang, and J. Tung.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-222250, Price codes: A02 in paper copy, A01 in microfiche. Arkansas Water Resources Research Center, University of Arkansas, Completion Report, March 31, 1980. 22 p, 5 Fig, 29 Ref. OWRT-B-056-ARK (1), 14-34-0001-8062.

Descriptors: *Pollutant identification, *Instrumentation, *Analytical techniques, *Laser-photoacoustics, *Prototypes, *Research and development, On-site investigations, Testing, Organic wastes, Trace elements, Chemical wastes, Water pollution, Energy, Absorption, Sound waves, Acoustics, Pressure, Pressure measuring instruments, Evaluation, Spectoscopy, Fluorescence, Measurement, Mathematical studies, Laser, Water analysis.

The development and application of a non-disturbing laser-photoacoustic technique for the detection of organic toxic pollutants in water is described in this project report. The laser-photoacoustic method utilizes a resonant modulated laser beam directed into the sample in its normal environment which produces heat, which then generates pressure fluctuations. These pressure fluctuations or sound waves are then detected by a sensitive hydrophone and the sensitivity is presently about one part in 10 to the 11th power for an organic dye pollutant. Since water itself absorbs energy in the ultraviolet and infra-red regions, this technique is limited to pollutants which absorb in the visible part of the spectrum. This problem can be overcome by the use of a pulsed laser which is modulated in frequency. The unwanted water absorption can be isolated and subtracted from the signal which results from the pollutant. The pulsed laser is tunable over a broad region (210 to 900 nanometers) which is suitable for the detection of such pollutants as heavy metal, acetone, benzene, and formaldehyde. The nature of the photoacoustic signal was also investigated in detail and it was concluded that the laser-photoacoustic method is easy to use, sensitive, and competitive with other analytical techniques. (Sidney-IPA)
W80-06508

A REEMPHASIS - GERM TUBES DIAGNOSTIC FOR CANDIDA ALBICANS HAVE NO CONSTRICTIONS,
Connecticut Univ., Groton. Marine Sciences Inst.
D. M. Hedden, and J. D. Buck.
Mycopathologia, Vol 70, No 2, p 95-101, 1980. 8 Fig, 20 Ref. OWRT-A-085-CONN (1).

Descriptors: *Yeasts, *Isolation, *Structure, *Cytological studies, Microorganisms, Sewage, Sewage bacteria, Diseases, Biochemistry, Microbiology, Evaluation, Sampling, Incubation, Physical properties, Separation techniques, Microscopy, Electron microscopy, Germ tubes, Constrictions, Candida albicans.

The lack of constrictions at the point of origin in the germ tubes of Candida albicans is emphasized. Clinical microbiologists must correctly identify yeast species because of their increasing significance in medicine. Much confusion in the differentiation of germ tubes from buds, pseudohyphae, and other cell extensions is apparent from the recent literature. To illustrate the matter of the morphological distinction of C. albicans germ tubes, samples of the yeast were isolated from raw sewage, transfered from Sabouraud dextrose agar to commercially available calf serum, and incubated at 37 degrees C for 3 hours. No constricted germ tubes were evident from phase microsopy of true C. albicans cells. Electron microscopic examination of cells grown in Sabouraud dextrose broth also revealed no constrictions. It is stressed that diagnostic workers should assign or accept identification of C. albicans based on careful consideration of all typical biochemical and morphological traits. (Sidney-IPA)
W80-06552

CHEMICAL, PHYSICAL, AND RADIOLOGICAL QUALITY OF SELECTED PUBLIC WATER SUPPLIES IN FLORIDA, JANUARY-MAY 1979,
Geological Survey, Tallahassee, FL. Water Resources Div.
B. J. Franks, and G. A. Irwin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-200 553, Price codes: A09 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-13, 1980. 183 p, 4 Fig, 8 Tab, 13 Ref.

Descriptors: *Water quality, *Water supply, *Potable water, *Florida, *Water treatment, Surface waters, Groundwater, Water quality standards, Water analysis, Chemical analysis, Desalination, Physical properties, *National Interim Primary and Proposed Secondary Drinking Water Regulations.

Most public water supplies sampled in Florida meet the maximum contaminant levels established by the National Interim Primary and Proposed Secondary Drinking Water Regulations. This conclusion is based on a water quality reconnaissance of 131 raw and treated public supplies throughout the State during the period January through May 1979. In a few water supplies, maximum contaminant levels, established by primary drinking water regulations, were exceeded for mercury, turbidity, and gross alpha particle activity. Secondary drinking water regulations also were occasionally exceeded in some public supplies for such parameters as chloride, pH, color, dissolved solids, iron, and manganese. These parameters, however, are more related to the esthetic quality of drinking water than to public health aspects. (USGS)
W80-06589

BIAS EVALUATION OF THE CATION-EXCHANGE METHOD FOR SULFATE AND CHLORIDE,
Wisconsin Univ. Madison. Water Chemistry Lab.
For primary bibliographic entry see Field 1A.
W80-06611

DETERMINATION OF SELECTED VOLATILE ORGANIC PRIORITY POLLUTANTS IN WATER BY COMPUTERIZED GAS CHROMATOGRAPHY-QUADRUPOLE MASS SPECTROSCOPY,
Geological Survey, Denver, CO.
W. E. Pereira, and B. A. Hughes.

Journal of the American Water Works Association, Vol 72, No 4, p 220-230, April 1980. 10 Fig, 7 Tab, 16 Ref.

Descriptors: *Pollutant identification, *Water pollution, *Gas chromatography, *Mass spectroscopy, Laboratory test, Instrumentation, Evaluation, Organic compounds, Aromatic compounds, Halogenated pesticides, Volatility, Thermal properties, Pollutants, Potable water, Adsorption, Standards, Reliability.

A method for the determination of nineteen spargeable priority pollutants in drinking water using gas chromatography-quadrupole mass spectrometry (GC-MS) techniques is described. The organic compounds were tentatively identified using relative gas chromatograph retention time data and their mass spectra were characterized with the aid of a computerized 'reverse library search' procedure. The GC-MS instrument was calibrated by an internally standardized sample containing about 25 microgram per liter of each component labeled with deuterium. The volatile organics are trapped on a porous polymeric adsorbent in a glass sparging vessel and thermally desorbed onto a gas chromatographic column where the components are separated, passed through a flame ionization detector, and then identified by their mass spectra after MS analysis. Several volatile priority pollutants were omitted because of the instability and rarity in natural waters. The precision and accuracy in the range of 5 to 50 microgram per liter shows good reproducibility. Chlorinated alkanes, chlorinated benzenes, toluene, benzene, and haloforms can be easily identified with this method. (Sidney-IPA)
W80-06638

THE DETERMINATION OF CHLOROPHYLL A IN WATER CONTAINING SEDIMENT,
Department of Water Affairs, Pretoria (South Africa), Hydrological Research Inst.
D. C. Grobler, and E. Davies.
Journal of the Limnological Society of Southern Africa (Pretoria), Vol 4, No 2, p 125-128, 1978. 1 Fig, 4 Tab, 20 Ref.

Descriptors: *Chlorophyll, *Water analysis, *Bottom sediments, *Evaluation, *Biomass, Chemical analysis, Sampling, Testing, Water quality, Standing crops, Dams, Eutrophication, Algae, Sediments, Sediment-water interfaces, Suspended solids, Particle size, Chemical properties, Nutrients, Mathematical studies, Least squares method, Bioassay, South Africa.

An evaluation of the suitability of chlorophyll a determinations in water samples as an estimate of algal biomass in the presence of different types of sediment was carried out. Bottom samples were collected in the Bloemhof Dam, South Africa, and chemical analysis and chlorophyll a determinations were conducted on the samples and compared to results from control samples. Two types of sediments were used in this study; sediment A, light colored and course textured, and sediment B, dark colored and fine textured. A decrease in mean chlorophyll a content occurred when 0.2% by mass sediment-containing samples were analyzed and sediment B, with the highest chemical activity, gave the greatest reduction. The responses of the chlorophyll a content to cell concentration in the presence of sediment B were markedly nonlinear and this rules out any simple correction factor. The use of chlorophyll a concentrations as an indicator of biomass in sediment rich water should be approached with care even though the 0.2% sediment content in this study is higher than would be normally found in natural water bodies. The use of chlorophyll a as an indicator of biomass in bioassays where sediment is used as a source of nutrients should not be employed because of the interferences caused by the presence of sediment on the determination of chlorophyll a. (Sidney-IPA)
W80-06648

THE CHEMICAL COMPOSITION OF WATER AND THE ANALYTICAL CHEMIST: A CHALLENGE,
Department of Water Affairs, Pretoria (South Africa). Hydrological Research Inst.
W. H. J. Hattingh.
Presented at the 26th Conference of the South African Chemical Institute, Port Elizabeth, South Africa, January 22-25, 1979. 14 p, 7 Fig, 8 Tab, 31 Ref.

Descriptors: *Water analysis, *Analytical techniques, *Automation, *Pollutant identification, *Instrumentation, Chemical analysis, Equipment, Measurement, Organic compounds, Spectroscopy, Water pollution, Detergents, Chlorine, Colorimetry, Laboratory tests, Research and development, Metals, Trace elements, Methodology, South Africa.

A review of the analytical tools available to South African chemists performing water analyses is presented. At the present rate of development in South Africa, it is estimated that demand for water would exceed the available supply for the year 2000. With this increase in demand, there has been a parallel increase in the number of identifiable components in water and the development of new analytical techniques and instruments. The identification of synthetic chemicals discharged into the water system such as synthetic detergents, pesticides, and chlorine have increased the need for reliable, efficient, and automated analyses to evaluate the quality of water resources. Atomic absorption introduced in 1957 has been invaluable in the determination of metals directly in water at low concentrations. Colorometric and selective membrane electrode analyses are also useful for metal determination. Organic constituents in water number 1,000 compounds and thin layer, gas-liquid, and high pressure liquid chromatography techniques are used to separate and detect these compounds. Use of an integrated gas chromatograph-mass spectrometer system is one of the most sensitive methods for the determination of organic constituents in water. The great number of identifiable compounds does not mean that any or all of them are hazardous to human health. With all the advances in automation and sensitivity, a chemist should not lose track of the interpretive and innovative skills in which chemists are trained. (Sidney-IPA)
W80-06649

THE EFFECTS OF TOXIC BLUE-GREEN ALGAE ON AQUATIC ANIMALS,
New Hampshire Univ., Durham. Dept. of Zoology.
J. J. Sasner, Jr., and M. Ikawa.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-103053, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Center, University of New Hampshire Research Report 28, 1980. 19 p, 1 Tab, 47 Ref, 1 Append. OWRT-A-047-NH (5), 14-34-0001-8031.

Descriptors: *Blue-green algae, *Toxicity, *Aquatic animals, *Algae, Toxins, Poisons, Lakes, Ponds, New England, Legal aspects, Public health, Animal physiology, Biotoxins, *Aphanizomenon flos-aquae, *Microcystis aeruginosa, *Anacystis cyanea, Fast Death Factor, Aphantoxin, Microcystin.

Toxic blue-green algae (Cyanobacteria) bloom in eutrophic, freshwater lakes and ponds in New England and have caused environmental, health, legal and recreational problems over the last 15 years. The most common offensive species were Aphanizomenon flos-aquae and Microcystis aeruginosa (a.k.a. Anacystis cyanea). Research has focused on: (1) toxin accumulation and identification from natural blooms and laboratory cultivation, (2) toxin assay, using the mouse bioassay and a new fluorometric method adapted for paralytic shellfish poisons, (3) toxin characterization and purification, using solvent separation and molecular weight filters, and (4) testing active extracts on whole animal and tissue preparations - to determine the specific sites and modes of action of aphantoxin (from A. flos-aquae) and FDF or microcystin (from M. aeruginosa). Microgram quantities of aphantoxin reversibly blocked action potentials in amphibian and crustacean axons as well as mechanical activity in skeletal muscle. No effect was measured on transmembrane resting potentials or on miniature end-plate potentials. Aphantoxins may block excitability by affecting ion conductance pathways, as do toxins from several marine dinoflagellates and thus may be useful for basic studies on membranes. Histological and ultrasturctural studies showed that microcystin had no effect on neuromuscular systems, but caused liver damage in mammals. Liver sinusoidal epithelium and hepatocyte plasma membranes ruptured causing severe hemorrhaging within 1 hour in toxin-treated mice and rats. The toxin only affected endothermic vertebrates.
W80-06687

EVALUATION OF THE ALGAL ASSAY BOTTLE TEST,
Water and Power Resources Service, Denver, CO. Engineering and Research Center.
R. A. Roline, and V. S. Miyahara.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-220783, Price codes: A03 in paper copy, A01 in microfiche. Report No REC-ERC-80-1, September 1979. 28 p, 7 Fig, 18 Tab, 18 Ref, 5 Append.

Descriptors: *Algae, *Testing procedures, *Water quality, Reservoirs, Rivers, Pollutants, Water quality control, Testing, Algal control, Freshwater, Methodology, Chemical analysis, Eutrophication, Surface waters, Water sources, Arizona, Colorado, South Dakota, Wyoming, Toxicity, Heavy metals, Water quality, Evaluation.

Water samples from sites in Arizona, Colorado, South Dakota, and Wyoming, were used to evaluate the algal assay bottle test (AABT). Selenastrum capricornutum Printz (ScP) selected by EPA due to its unicellar nature (allowing for electronic cell counting) and its wide adaptability to various water types, was used as the test algae. Following water sample collection, addition of a standard nutrient solution of salts (Table 1), autoclaving, inoculation with the ScP and incubation, algal growth was measured (ZBI Coulter Counter; pH; dry mass) at 7, 14, and 21 days. Cell counts and dry mass were the best indicators of algal production. While ScP may not be the best test organism for all fresh waters, it responded positively to an increase in nutrient concentration. Some growth inhibition may have been due to high salinity or toxic elements (heavy metals, herbicides) in the water systems. Water quality predictions in reservoir planning can be made using AABT results, but, since the test is still not totally conclusive, predictions should be used judiciously. Five Appendices list the results of algae growth potential (AGP) studies using AABT for the Boysen Reservoir, Uncompahgre River, and Big Sioux River. (Zielinski-IPA)
W80-06711

FISH USED TO DETECT TOXIC WASTE IN EFFLUENT.
Public Works Construction and Transport (Johannesburg), p 10-13, February, 1979. 1 Fig.

Descriptors: *Pollutant identification, *Fish, *Warning systems, *Instrumentation, *Bioindicators, Safety, Water pollution, Effluents, Water pollution effects, Industrial wastes, Toxins, Equipment, Electrodes, Monitoring, Electrochemistry, Movement, Fish physiology, Evaluation, Maintenance, Toxicity, Bioassay, Public health, South Africa.

A biological automatic monitoring system for detecting toxic wastes in an effluent using fish as sensors is described. The National Institute for Water Research in South Africa developed this method to provide a safeguard against industrial and other pollution. An electrode chamber containing fish (sensors) provides the input signals. These signals result from a change in the electrical potential between two stainless steel electrodes brought about by the opercular (gill) movement of the fish. Other detected movements are filtered out electronically. Twelve fish are monitored in twelve independent tanks with a twelve-channel multipoint recorded with an alarm system. The toxicant is defined as being detected when at least 60% of the fish react with increased opercular activity. Fish have been shown to be more sensitive to acute intoxication by pollutants than

humans in 97% of the cases studied and the severity of the pollutant can be judged by the time it takes a certain number of fish to respond. The monitoring system required little maintenance and it can be easily operated by unskilled personnel. (Sidney-IPA)
W80-06716

DEVELOPING A TOXICITY TESTING CAPABILITY FOR AUSTRALIA,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
J. Cairns, Jr.
Water, Vol 7, No 1, p 14-15, 1980. 3 Ref.

Descriptors: *Water pollution, *Effluents, *Industrial wastes, *Fish toxins, *Bioassay, Testing procedures, *Australia, *Toxicity, Water pollution effects, Water pollution sources, Toxins, Zinc, Pathology, Quality control, On-site tests, Water analysis, Fish, Assay, Waste disposal, Water quality, United States, Europe.

An Australian strategy was outlined for coping with toxic chemicals in the aquatic environment to both control ecosystem degradation and allow industry to continue to function. Experience gained in North America and Europe is used to formulate a set of proposals. Seven priority tasks are proposed; (1) conduct toxicant (e.g., Zn, phenol) tests on fish species to determine reaction differences relative to European-American fishes to assist transfer and use of existing literature on toxicant data; (2) develop a capability for acute tests with at least three trophic levels (algae, invertebrates, fishes); (3) use standard 'white rat' species (rainbow trout, flathead minnow) until laboratory maintenance methods for Australian species are established; (4) immediately establish laboratory cultures of several Australian species to determine toxicants sensitivity of life history stages; (5) develop a mobile laboratory for on-site evaluation of unstable and/or highly variable industrial effluents; (6) insure the availability of high quality test water; and (7) develop standard short-term acute bioassays using 'production' methods to reduce costs. Rationales for these proposed tasks were elaborated. Australia might benefit by following some of the bioassay approaches and priorities considered by various States in the United States. (Zielinski-IPA)
W80-06734

LESSONS LEARNED FOR THE MANAGEMENT OF OIL SPILL INVESTIGATIONS,
Swedish Water and Air Pollution Research Inst., Stockholm.
For primary bibliographic entry see Field 5C.
W80-06739

DETERMINATION OF TOTAL DISSOLVED PHOSPHORUS AND PARTICULATE PHOSPHORUS IN NATURAL WATERS,
Delaware Univ., Lewes. Coll. of Marine Studies.
L. Solorzano, and J. H. Sharp.
Limnology and Oceanography, Vol 25, No 4, p 754-758, July 1980. 1 Tab, 22 Ref. NSF OCE 76-82571.

Descriptors: *Phosphorus, *Laboratory tests, *Testing procedures, *Sea water, Methodology, Water quality, Suspended solids, Dissolved phosphorus.

Procedures were presented for separate analyses of total dissolved phosphorus and total particulate phosphorus in natural waters. The method for both procedures involves drying a sample with magnesium sulfate and baking the residue at a high temperature to decompose organic phosphorus compounds. The residue is then treated with hydrochloric acid to hydrolyze polyphosphates, and the orthophosphate is measured by the molybdate method. The method gives 100% recovery with refractory phosphorus compounds, is usable on undiluted samples with up to 18 micromol of phosphorus per liter (6 micrograms P per sample), and has a mid-range precision of + or - 1%. (Humphreys-ISWS)
W80-06767

DETERMINATION OF TOTAL DISSOLVED NITROGEN IN NATURAL WATERS,
Delaware Univ., Lewes. Coll. of Marine Studies.
L. Solorzano, and J. H. Sharp.
Limnology and Oceanography, Vol 25, No 4, p 751-754, July 1980. 1 Tab, 9 Ref. NSF OCE 76-82571.

Descriptors: *Nitrogen, *Laboratory tests, *Methodology, *Testing procedures, Sea water, Freshwater, Water quality, Analytical techniques, Dissolved nitrogen.

A procedure was presented for routine analysis of total nitrogen in solution which is similar to published methods using oxidation by potassium persulfate. Careful attention to pH, alkalinity, the neutralizing buffer, reaction vessels, and dilution factors proved necessary. This modified method is acceptable for samples from fresh to oceanic waters, is accurate for organic compounds tested, has a maximum capability of 40 micro M nitrogen in undiluted samples, and has a mid-range precision of + or - 2%. (Humphreys-ISWS)
W80-06768

EVALUATION OF THE MODIFIED COLOURIMETRIC METHOD FOR THE DETERMINATION OF MALATHION: ITS APPLICATION TO THE ANALYSIS OF MALATHION RESIDUES IN WATER,
Aston Univ., Birmingham (England). Dept. of Chemistry.
E. R. Clark, and I. A. Qazi.
Water Research, Vol 14, No 8, p 1037-1040, 1980. 4 Tab, 25 Ref.

Descriptors: *Chemical analysis, *Insecticides, *Phosphothioate pesticides, *Analytical techniques, Pesticides, Organic pesticides, Organic compounds, Water pollution, Pollutants, Pollutant identification, Chemistry, Colorimetry, Aqueous solutions, *Malathion.

The feasibility of the modified colorimetric method for the analysis of malathion has been demonstrated previously. This publication describes the development of a complete analytical scheme based on the same method for the analysis of aqueous solutions of malathion. In the work described, synthetic aqueous solutions containing malathion in ppm concentration have been analyzed, but it is possible to extend the method to ppb with a few minor modifications. (Sims-ISWS)
W80-06776

A COMPARISON OF DIFFERENT METHODS FOR MEASURING SOIL SALINITY,
Agricultural Research Organization, Bet Dagan (Israel). Div. of Soil Physics.
A. Nadler, and S. Dasberg.
Soil Science Society of America Journal, Vol 44, No 4, p 725-728, July-August 1980. 2 Fig, 6 Tab, 11 Ref.

Descriptors: *Salinity, *Soils, *Instrumentation, *Saline soils, Measurement, On-site tests, Conductivity, Electrical conductance, Methodology, On-site data collections, Testing procedures, Electrodes, Soil water, Moisture content, Soil salinity, Salinity probe, Multi-electrode probe.

Soil salinity measurements with in situ salinity sensors, a four-electrode salinity probe, a four-electrode Wenner array, and a multi-electrode probe were compared in an experimental plot irrigated with 3.1 mmho/cm CaCl2. Good agreement was obtained among expected salinity, soil extract (1:1) EC (electrical conductivity), and EC measurements with the salinity probe. The salinity probe requires good electrode-soil contact and is therefore limited to the higher range of soil water contents. The Wenner array functions also at lower water contents, but interpretation of the results was influenced by soil layering. Salinity sensors gave the highest variance in the results. (Humphreys-ISWS)
W80-06837

AN AUTOMATED METHOD FOR THE DETERMINATION OF TOTAL INORGANIC CARBON IN FRESH WATER,
Department of Water Affairs, Pretoria (South Africa). Hydrological Research Inst.
L. R. Gravelet-Blondin, H. R. Van Vliet, and B. W. H. Schoones.
Water S. A., Vol 6, No 3, p 135-137, July, 1980. 3 Fig, 2 Tab, 5 Ref.

Descriptors: *Freshwater, *Chemical analysis, *Inorganic compounds, *Testing procedures, *Colorimetry, Carbon dioxide, Analytical techniques, Water quality, Water quality control, Bicarbonates, Carbon, Water sampling, Water chemistry, Water analysis, Water pollution, Analysis, Instrumentation, Testing, Indicators, Laboratory tests, Automation.

The sample stream was segmented with air free of carbon dioxide, acidified, and heated to 37 degrees to release carbon dioxide from dissolved inorganic carbon. A gas-permeable silicone membrane was used to introduce the evolved carbon dioxide into a weakly buffered thymol blue indicator solution. The color change, measured at 590 nm, was found to be directly proportional to the inorganic carbon content of the water. The method was linear over the calibration range of 50-500 mg of total inorganic carbon per liter bicarbonate anion. Two water samples were tested ten times each to determine method precision, with the finding of a coefficient of variation of less than 1.1% for each measurement set. Recoveries were determined on two water samples, with aliquots of each spiked with 0.5, 1.0, and 1.5 ml of a standard solution of 1 g/l bicarbonate. Recoveries averaged between 98% and 102%. Automation of the method was based on use of a Technicon AutoAnalyzer containing sampler IV, a manifold with a 150 mm dialyzer (60 micron pore size membrane), and a colorimeter having 500 nm filters and 15 mm industrial flow cells, assembled as in the schematic provided in Figure 1. (Zielinski-IPA)
W80-06854

AN AUTOMATED METHOD FOR THE DETERMINATION OF DISSOLVED ORGANIC CARBON IN FRESH WATER,
Department of Water Affairs, Pretoria (South Africa). Hydrological Research Inst.
L. R. Gravelet-Blondin, H. R. Van Vliet, and P. A. Mynhardt.
Water S. A., Vol 6, No 3, p 138-143, July, 1980. 5 Fig, 5 Tab, 16 Ref.

Descriptors: *Freshwater, *Chemical analysis, *Organic compounds, *Testing procedures, *Colorimetry, Carbon dioxide, Analytical techniques, Water quality, Water quality control, Chemical reactions, Carbon, Water sampling, Water chemistry, Automation, Water analysis, Water pollution, Analysis, Instrumentation, Testing, Indicators, Laboratory tests.

A simple automated method was developed for the measurement of dissolved organic carbon (DOC) in fresh water. Automation was carried out using a Technicon Auto-Analyzer comprising sampler IV, manifold and colorimeter with 590 nm filters and 15 mm industrial flow cells, a 150 mm dialyzer containing a 60 micron pore gas-permeable silicone membrane, and a 254 nm UV light source. The flow diagram of the automated system is illustrated. The sample stream, segmented with carbon dioxide-free air, was acidified, heated (56 degrees) and sparged with nitrogen (350 ml/min) to remove inorganic carbon. The re-sampled stream, again segmented with carbon dioxide-free air, was mixed with a solution of potassium persulfate and mercury (II) nitrate and subjected to UV radiation, oxidizing the DOC to carbon dioxide which entered a weakly buffered pH 9.6 thymol blue indicator solution through the gas-permeable membrane. The measured color change was directly proportional to the amount of DOC in the water sample. Oxidation efficiency for seven organic compounds tested, was generally better than 95%. Percent recovery for the DOC method from raw water samples ranged from 99.9-104.8%. Method reproducibility for analysis of standard solutions or raw water showed a coefficient of variation of 1.2% or less. (Zielinski-IPA)

W80-06855

5B. Sources Of Pollution

TRIHALOMETHANE LEVELS IN PUBLIC WATER SUPPLIES DRAWN FROM THE SACRAMENTO RIVER SYSTEM,
California Dept. of Health Services, Berkeley.
S. J. Nelson, and S. Khalifa.
American Water Works Association Journal, Vol 72, No 7, p 423-426, July 1980. 7 Fig, 9 Ref.

Descriptors: *Water quality, *Water analysis, *California, *Water pollution sources, Sampling, Data collections, *Saline water intrusion, Bromides, Chemical oxygen demand, Organic compounds, Water treatment, Chemical analysis, Analysis, Public health, Water pollution, Surface waters, Water supply, Public water systems, *Sacramento River(CA), *Trihalomethanes.

Water samples were collected from nine public water systems treating water obtained from the Sacramento River system. Trihalomethanes (THM) were present in all raw waters, with concentrations in some ranging as high as 25 micrograms/L. As expected, THM levels were higher in finished waters. Considerably more THMs were formed in Sacramento River delta supplies, irrespective of the degree of seawater intrusion. The primary effect of seawater intrusion was to increase bromination of THMs. THM formation in the river system as a whole did not correlate with either COD or TOC levels. THM formation in treated Contra Costa Canal water correlated well with the Delta Outflow Index. (Preece-ISWS)
W80-06493

SATELLITE OBSERVATIONS OF A NUTRIENT UPWELLING OFF THE COAST OF CALIFORNIA,
Naval Postgraduate School, Monterey, CA. Dept. of Oceanography.
For primary bibliographic entry see Field 2L.
W80-06499

RECONNAISSANCE OF POLYCHLORINATED BIPHENYLS IN THE ARKANSAS RIVER BETWEEN MUSKOGEE AND WEBBERS FALLS LOCK AND DAM, OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
J. D. Stoner.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $1.25 in paper copy, $3.50 in microfiche. Geological Survey open-file report 80-216, March 1980. 6 p, 1 Fig, 1 Tab, 2 Ref.

Descriptors: *Polychlorinated biphenyls, *Water analysis, *Rivers, *Oklahoma, *Water quality, Bottom sampling, Organic wastes, Water pollution effects, *Arkansas River(OK).

Analysis of samples collected from the Arkansas River between Muskogee and Webbers Falls Lock and Dam, Oklahoma, in November 1978 showed that concentrations of polychlorinated biphenyls in the dissolved and suspended phases were less than the detection limit of 0.1 micrograms per liter. The maximum polychlorinated biphenyl concentration measured in samples of the bottom material was 16 micrograms per kilogram and occurred 5.9 miles below the U.S. Highway 62 bridge in Muskogee.
W80-06514

APPRAISAL OF GROUND WATER IN THE VICINITY OF THE LEADVILLE DRAINAGE TUNNEL, LAKE COUNTY, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
J. T. Turk, and O. J. Taylor.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $3.50 in paper copy, $3.50 in microfiche. Geological Survey open-file report 79-1538, November 1979. 24 p, 10 Fig, 5 Tab, 13 Ref.

Descriptors: *Groundwater, *Mine water, *Mine drainage, *Aquifer systems, *Colorado, Heavy metals, Water pollution sources, Tunnels, Water levels, *Lake County(CO), *East Fork Arkansas River(CO), *Leadville drainage tunnel(CO).

Ground water in the Leadville mining district occurs in granite, quartzite, limestone, sandstone, porphyry dikes, and unconsolidated material. These rocks form a single aquifer system because the formations are hydraulically connected through contact, mine workings, faulting, and fracturing. The aquifer is recharged by precipitation and water moves toward California Gulch and probably toward Evans Gulch, in the drainage basin of the Arkansas River. The Leadville drainage tunnel was constructed from 1943 to 1945 and later extended during 1950 to 1952, in order to drain the mine workings. Discharge from the tunnel lowered water levels 30 to 96 feet in mine shafts from 1944 to 1951. Installation of an impervious plug in the tunnel has been proposed in order to reduce the discharge of water containing objectionable concentrations of trace metals into the East Fork Arkansas River. The proposed plug would reduce the discharge from the tunnel, cause water levels east of the town of Leadville to rise, flood some mine workings, and increase groundwater discharge to California Gulch. However, the proposed plug is not expected to cause water levels in Leadville to rise substantially, but more current and detailed data are needed to verify this. Discharge from the Leadville drainage tunnel is probably a mixture of water in equilibrium with carbonate aquifer materials from the mineralized zone, water acidified by the localized oxidation of pyrite from the mineralized zone, and water nearly saturated with calcite from the glacial mantle. Based on limited data, water from the carbonate mineral deposits has a pH of about 7.0 and concentrations of manganese of about 1,800 micrograms per liter and zinc concentrations of about 13,000 micrograms per liter. (USGS)
W80-06516

GROUND-WATER QUALITY IN SELECTED AREAS OF WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 2K.
W80-06518

WATER-QUALITY CONDITIONS IN THE MILNER REACH, SNAKE RIVER, SOUTH-CENTRAL IDAHO, OCTOBER 18-21, 1977,
Geological Survey, Boise, ID. Water Resources Div.
W. H. Low.
Geological Survey open-file report 80-510, April 1980. 35 p, 6 Fig, 12 Tab, 14 Ref.

Descriptors: *Water quality, *Path of pollutants, *Streamflow, *Water analysis, Nutrients, Biochemical oxygen demand, Bacteria, Trace elements, Heavy metals, Fish toxins, Water quality standards, Low flow, *Snake River(ID), South-central Idaho.

During late October 1977, water discharge from Minidoka Dam into the Milner reach of the Snake River was less than 22 cubic meters per second, compared to normal flows for that time of year of about 42 cubic meters per second or more. To determine if impaired water-quality conditions existed, samples were collected at several sites above and below major point-source waste discharges near Burley, Idaho. Data collected for this study indicate some water-quality impairment within the study reach. At site 15 near Milner Dam, dissolved oxygen was below the 90 percent saturation standard prescribed by the Idaho water-quality standards. The total coliform and fecal coliform standards were exceeded at about one-third of the sites sampled on the main stem of the Snake River. Unionized ammonia concentration exceeded U.S. Environmental Protection Agency water-quality criteria at one site near Burley. Concentrations of trace metals, insecticides, and herbicides were all low; none exceeded existing criteria. (USGS)
W80-06519

QUALITY OF WATER AND TIME OF TRAVEL IN HOBOLOCHITTO CREEK, PEARL RIVER COUNTY, MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
G. A. Bednar.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $5.00 in paper copy, $3.50 in microfiche. Geological Survey open-file report 80-203, 1980. 36 p, 7 Fig, 1 Tab, 9 Ref.

Descriptors: *Water quality, *Path of pollutants, *Mississippi, *Streamflow, *Flow rates, Surface waters, Data collections, Water temperature, Chemical analysis, Wastes, Dye releases, Tracking techniques, *Time-of-travel study, *Hobolochitto Creek(MS), *Pearl River County(MS).

In Mississippi, an intensive study of Hobolochitto Creek, including the lower parts of East and West Hobolochitto Creeks, was conducted on September 12-14, 1978. The quality-of-water data were collected during a period of generally low streamflow and seasonally high air temperatures. These data show that the quality of water in Hobolochitto Creek was generally good. The dissolved-solids concentrations were less than 50 milligrams per liter, and the concentrations of nitrogen and phosphorus species were low. The 5-day biochemical oxygen demand generally was minimal, and dissolved-oxygen concentrations were at levels that could support aquatic life. Several water samples contained high fecal bacteria densities and there was evidence of the presence of wastes of human origin, particularly at the downstream sites on Hobolochitto Creek. It was determined from a time-of-travel study that the rate of solute travel is very slow at low streamflow. A peak dye concentration traveled through a 3.7-mile reach of Hobolochitto Creek in 23.5 hours. (USGS)
W80-06522

GLACIAL GEOLOGY AND STRATIGRAPHY OF WESTERN NEW YORK NUCLEAR SERVICE CENTER AND VICINITY, CATTARAUGUS AND ERIE COUNTIES, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 2C.
W80-06531

ENVIRONMENTAL FACTORS IN APPLICATION OF LIQUID SLUDGE TO UPSTATE NEW YORK FARMLANDS,
Technical Completion Report State Univ. of New York at Binghamton. Dept. of Chemistry.
For primary bibliographic entry see Field 5E.
W80-06564

HYDROGEOLOGIC DATA FOR EUREKA SPRINGS LANDFILL AND ADJACENT AREA, NORTH-CENTRAL HILLSBOROUGH COUNTY, FLORIDA, 1969-73,
Geological Survey, Tallahassee, FL. Water Resources Div.
A. D. Duerr, and J. W. Stewart.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $11.00 in paper copy, $3.50 in microfiche. Geological Survey open-file report 80-70, 1980. 83 p, 3 Fig, 9 Tab, 6 Ref.

Descriptors: Landfills, *Groundwater, *Water quality, *Florida, Observation wells, Solid wastes, Path of Pollutants, Hydrogeology, Aquifer characteristics, Water levels, Chemical analysis, Well data, Data collections, Water analysis, Nitrogen, Phosphorus, Trace elements, Metals, Biochemical oxygen demand, *Eureka Springs landfill(FL), *Hillsborough County(FL).

Well location and construction data are summarized for 218 wells in the Eureka Springs landfill and adjacent areas in north-central Hillsborough County, FL. Most of the data are for 88 wells within the immediate vicinity of the landfill. Water-quality data are presented for 93 of the wells and 13 surface-water sites. Also presented are water-level data for the surficial and Floridan aquifers for 162 of the wells and lithologic logs for 43 of the wells. (USGS)

W80-06580

GEOHYDROLOGY OF HOLE UE-17A, SYNCLINE RIDGE AREA, NEVADA TEST SITE,
Geological Survey, Denver, CO. Water Resources Div.
J. E. Weir, Jr., and J. N. Hodson.
Available from the National Technical Information Service, Springfield, VA 22161 as USGS-1543-4, Price codes: A02 in paper copy, A01 in microfiche. Department of Energy, Nevada Operations Office, USGS-1543-4, 1979. 18 p, 4 Fig, 2 Tab, 4 Ref.

Descriptors: *Hydrogeology, *Nevada, *Nuclear wastes, *Waste storage, Aquifer characteristics, Drill holes, Testing, Hydraulics, Groundwater movement, Transmissivity, Water levels, Water quality, Chemical analysis, Water pollution sources, Path of pollutants, *Nevada test site(NV).

Hole UE-17a was drilled as a part of a study to evaluate the suitability of Unit J of the Eleana Formation of Mississippian age as a medium for storage of nuclear wastes. The 1,214-foot hole penetrated alluvium of Quaternary age, a thrust plate of the Tippipah Limestone of Pennsylvanian and Permian age, and 668 feet of the Eleana Formation. A small amount of ground water occurs in fractured quartzites and limestones of the Eleana Formation; jetting produced only 20 gallons per minute from the completed hole. Approximate transmissivity, calculated from jetting test results, is 1.2 feet squared per day. The hydraulic head has almost steadily declined in the hole since September 29, 1976, a few days after the hole was completed. Water from the Eleana Formation is a sodium bicarbonate and sodium sulfate type. (USGS)
W80-06582

A ONE-DIMENSIONAL, STEADY-STATE, DISSOLVED-OXYGEN MODEL AND WASTE-LOAD ASSIMILATION STUDY FOR WEST FORK BLUE RIVER, WASHINGTON COUNTY, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
J. G. Peters, W. G. Wilber, C. G. Crawford, and F. P. Girardi.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $6.75 in paper copy, $3.50 in microfiche. Geological Survey open-file report 79-1479, October 1979. 47 p, 16 Fig, 11 Tab, 37 Ref.

Descriptors: *Model studies, *Dissolved oxygen, *Waste assimilative capacity, Water quality, *Indiana, Streams, Streamflow, Low-flows, Reaeration, Water pollution, Waste water disposal, Waste water treatment, Biochemical oxygen demand, Nitrification, Ammonia, Nitrates, Nutrients, Mathematical models, *Washington County(IN), *West Fork Blue River(IN).

A digital computer model calibrated to observe stream conditions was used to evaluate water quality in West Fork Blue River, Washington County, IN. Instream dissolved-oxygen concentration averaged 96.5% of saturation at selected sites on West Fork Blue River during two 24-hour summer surveys. This high dissolved-oxygen concentration reflects small carbonaceous and nitrogenous waste loads; adequate dilution of waste by the stream; and natural reaeration. Nonpoint source waste loads accounted for an average of 53.2% of the total carbonaceous biochemical-oxygen demand and 90.2% of the nitrogenous biochemical-oxygen demand. Waste-load assimilation was studied for critical summer and winter low flows. Natural streamflow for these conditions was zero, so no benefit from dilution was provided. The projected stream reaeration capacity was not sufficient to maintain the minimum daily dissolved-oxygen concentration (5 milligrams per liter) in the stream with current waste-discharge restrictions. During winter low flow, ammonia toxicity, rather than dissolved-oxygen concentration, was the limiting water-quality criterion downstream from the Salem wastewater-treatment facility. (USGS)
W80-06584

A ONE-DIMENSIONAL, STEADY-STATE, DISSOLVED-OXYGEN MODEL AND WASTE-LOAD ASSIMILATION STUDY FOR THE MISSISSINEWA RIVER, GRANT COUNTY, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
W. G. Wilber, C. G. Crawford, and J. C. Peters.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $13.50 in paper copy, $3.50 in microfiche. Geological Survey open-file report 79-1534, October 1979. 98 p, 27 Fig, 14 Tab, 45 Ref.

Descriptors: *Model studies, *Dissolved oxygen, *Waste assimilative capacity, *Water quality, Indiana, Streams, Streamflow, Low-flows, Reaeration, Water pollution, Waste water disposal, Waste water treatment, Biochemical oxygen demand, Nitrification, Ammonia, Nitrates, Nutrients, Mathematical models, *Grant County(IN), *Mississinewa River(IN).

A digital model calibrated to conditions in the Mississinewa River, Grant County, IN was used to develop alternatives for future waste loadings that would be compatible with Indiana stream water-quality standards defined for two critical hydrologic conditions, summer and winter low flows. The hydrology of the Mississinewa River downstream from Gas City is controlled primarily by two factors; low slopes, typical of the Tipton Till Plain, and a 10-foot dam at river mile 35.9, in Marion. All point-source waste loads affecting the modeled segment of the Mississinewa River are in the four incorporated municipalities of Fairmount, Jonesboro, Gas City, and Marion, in a primarily agricultural area. Model simulations indicate that algal photosynthesis and nitrification are the most significant factors affecting the dissolved-oxygen concentration in the Mississinewa River during summer low flows. Natural reaeration without photosynthesis, is not sufficient to maintain an average dissolved-oxygen concentration of at least 5 milligrams per liter in the stream, the State's water-quality standard. Projected carbonaceous and nitrogenous biochemical-oxygen demand loads, from the Indiana State Board of Health, for Owens, Illinois, Inc., and the Gas City and Marion wastewater-treatment facility will result in violations of the instream dissolved-oxygen standard. Fairmount and Jonesboro, because of their distance from the Mississinewa, do not significantly affect the water quality of the modeled segment. The model also indicates that, during winter low flows, ammonia toxicity, rather than dissolved oxygen is the limiting water-quality criterion in the Mississinewa River downstream from the Gas City wastewater-treatment facility. (USGS)
W80-06585

USE OF THE STORM MODEL FOR ESTIMATING THE QUANTITY AND QUALITY OF RUNOFF FROM THE METROPOLITAN AREA OF HOUSTON, TEXAS,
Geological Survey, Austin, TX. Water Resources Div.; and Geological Survey, Bay St. Louis, MS. Water Resources Div.
K. M. Waddell, B. C. Massey, and M. E. Jennings.
Geological Survey Water-Resources Investigations 79-74, 1979. 29 p, 5 Fig, 6 Tab, 4 Ref.

Descriptors: *Computer models, *Urban hydrology, *Water quality, *Streamflow, Storm runoff, Water pollution sources, Rainfall-runoff relationships, Reservoir storage, Low flow, Model studies, Hydrologic data, Texas, *STORM, *Houston(TX).

The 'STORM' model (storage, treatment, overflow, and runoff model), developed by the U.S. Army Corps of Engineers, was selected from existing models and adapted to use available data to compute runoff from the Houston, TX, area and to compute the loads and concentrations of biochemical-oxygen demand, dissolved solids, total phosphorus, total organic carbon, total nitrogen, and fecal-coliform bacteria. Discharge and precipitation data for the 1975 water year and all available water-quality analyses were used to calibrate the model. Data for the 1974 water year were used to verify the model for discharge. After verification, the calibrations were adjusted to balance the difference between the 1974 and 1975 error predictions for discharge. The adjusted model was used with records of precipitation and evaporation to simulate a 20-year record of the quantity and quality of runoff from the modeled area. The percentage of difference for the 1975 water year between the observed and computed concentrations of the water-quality constituents ranged from -21 to +8 percent for dissolved solids, -56 to +31 percent for total organic carbon, 0 to +83 percent for biochemical-oxygen demand, -13 to +50 percent for total nitrogen, -40 to +133 percent for total phosphorus, and -33 to +140 percent for fecal-coliform bacteria. The percentage of difference between the observed and computed discharge for the 1975 water year ranged from -9 to +5 percent. (USGS)
W80-06594

WESTMINSTER QUADRANGLE: GEOLOGY, HYDROLOGY, AND MINERAL RESOURCES,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W80-06597

WINFIELD QUADRANGLE: GEOLOGY, HYDROLOGY, AND MINERAL RESOURCES,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W80-06598

NEW WINDSOR QUADRANGLE, MARYLAND: GEOLOGY, HYDROLOGY, AND MINERAL RESOURCES,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W80-06599

VARIABILITY OF PARTICULATE MATTER IN A SMALL COASTAL INLET,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.
For primary bibliographic entry see Field 2L.
W80-06610

A MATHEMATICAL MODEL FOR ESTIMATING PESTICIDE LOSSES IN RUNOFF,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
D. A. Haith.
Journal of Environmental Quality, Vol 9, No 3, p 428-433, July-September 1980. 1 Fig, 5 Tab, 26 Ref.

Descriptors: *Water pollution sources, *Agricultural watersheds, *Pesticides, *Runoff, Hydrographs, Watersheds(Basins), Model studies, Mathematical models, Forecasting, Water quality, Agricultural runoff, Soil erosion, Analytical techniques, Small watersheds, On-site data collections, Nonpoint source pollution, Atrazine.

A simple mathematical model was proposed for the estimation of losses of dissolved and solid-phase pesticide in cropland runoff. The model was designed for use in water quality and pesticide screening studies for which field pesticide runoff data are unavailable. The model is based on commonly used methods for runoff and soil loss predictions and does not require calibration. A comparison of model predictions with measured atrazine (2-chloro-4(ethylamino)-6-(isopropylamino)-s-triazine) losses from two small Georgia watersheds indicated that the model provides a reasonable means of estimating the approximate magnitudes of long-term (3 years for the two watersheds) total pesticide runoff losses. Although large errors were sometimes observed in estimates of losses from single runoff events, the observed variations in pesticide losses among events and the distribution of these losses into dissolved and solid-phase components were reflected in model predictions. (Humphreys-ISWS)
W80-06616

AREAL, VERTICAL, AND TEMPORAL DIFFERENCES IN GROUND WATER CHEMISTRY: I. INORGANIC CONSTITUENTS,
Nebraska Univ., Lincoln. Conservation and Survey Div.
R. F. Spalding, and M. E. Exner.
Journal of Environmental Quality, Vol 9, No 3, p 466-479, July-September 1980. 11 Fig, 3 Tab, 33 Ref.

Descriptors: *Groundwater, *Water quality, Monitoring, *Distribution, *Nebraska, Spatial distribution, Temporal distribution, On-site investigations, Water chemistry, Land use, Leaching, Seepage, Rivers, Dissolved solids, Ions, Aquifers, Data collections, Calcium, Magnesium, Sulfates, Chlorides, Fluorides, Sodium, Potassium, Carbonates, Nitrogen, Water temperature, Hydrogen ion concentrations, Phosphorus, Silica, *Geochemistry, *Platte River(NE), Inorganic constituents.

Definite areal, vertical, and temporal differences were observed in the groundwater chemistry of a 62 sq km area in Nebraska's Platte Valley. A network of 53 wells was monitored 10 times between July 1975 and July 1976 for dissolved solids, Ca(2+), Mg(2+), Na(+), K(+), HCO3(-), SO4(2-), Cl(-), F(-), NO3-N, PO4-P, SiO2, pH, and temperature. Areal differences are most pronounced in the shallow groundwater and reflect upgradient land use and soil type. Average total dissolved solids (TDS) and nitrate-nitrogen (NO3-N) concentrations range from 557 to 2,210 mg/liter and from 0.1 to 33 mg/liter, respectively, with the lowest concentrations occurring downgradient from near-pristine areas and the highest concentrations occurring downgradient from cultivated and irrigated fields. In groundwater downgradient from cultivated and irrigated fields, most of the chemical parameters have pronounced decreases in concentration with depth. Stratification is more pronounced in the bottomland than in the terrace, and in the latter reflects mixing of the groundwater caused by intensive pumping of irrigation water during the last four decades. Magnesium and potassium markedly decrease with depth regardless of upgradient land use. Marked cyclic fluctuations in NO3-N and SO4(2-) concentrations generally were observed in the bottomland groundwater. Sulfate concentrations, which were correlated significantly with TDS, Ca(2+), Mg(2+)Na(+), and Cl(-) (r equal to or greater than +0.89), peak in late winter and early spring. Groundwater in secondary aquifers confined within or beneath a layer of clayey silt has an average TDS concentration of 304 mg/liter and almost negligible amounts (equal to or less than 0.1 mg/liter) of NO3-N. Temporal fluctuations in chemical constituents from these aquifers were the smallest observed within the study area. (Humphreys-ISWS)
W80-06617

AREAL, VERTICAL, AND TEMPORAL DIFFERENCES IN GROUND WATER CHEMISTRY: II. ORGANIC CONSTITUENTS,
Nebraska Univ., Lincoln. Conservation and Survey Div.
G. A. Junk, R. F. Spalding, and J. J. Richard.
Journal of Environmental Quality, Vol 9, No 3, p 479-483, July-September 1980. 1 Fig, 1 Tab, 17 Ref.

Descriptors: *Groundwater, Monitoring, *Water quality, *Distribution, *Nebraska, Pesticides, Herbicides, Water chemistry, Dieldrin, Organic matter, Areal, On-site investigations, Data collections, Aquifers, Water wells, Nitrogen, Spatial distribution, Temporal distribution, Water pollution sources, *Geochemistry, *Platte River(NE), Organic constituents, Alachlor, Atrazine, Dissolved organic carbon.

Selected organic components in samples collected from monitoring wells and from surface water were shown to follow definite areal, vertical, and temporal trends in concentration. Atrazine (2-chloro-4-(ethylamino)-6(isopropylamino)-s-triazine), alachlor (2-chloro-2',6'-diethyl-N-(methoxymethyl)acetanilide) and dieldrin (1,2,3,4,10,10-hexachloro-exo-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo, exo-5,8-dimethano-naphthalene) were measured in 64, 35, and 35 water samples, respectively. The atrazine amounts range from less than 0.01 to 88 microgram/liter. Peak concentrations were observed in shallow well water downgradient from irrigated fields at the end of the irrigation season. The areal and vertical distributions of atrazine are closely associated with those of nitrate-nitrogen (NO3-N), which was measured as an indicator of deep percolation from irrigated croplands. However, temporal variations in atrazine concentrations suggest that it is a nonconservative constituent of groundwater. Alachlor and dieldrin amounts are extremely low, being less than 0.1 microgram/liter in all but one water sample that was taken from a well located in an excessively well-drained area. Dissolved organic carbon (DOC) was measured in 95 water samples and the amounts range from 0.2 to 4.8 mg/liter. Maximums occur in shallow wells and there are no seasonal associations with either atrazine or NO3-N. The DOC data suggest percolation from the unsaturated zone and partial removal from solution during vertical transport within the saturated zone. (Humphreys-ISWS)
W80-06618

EFFECT OF GRASS BUFFER ZONE LENGTH IN REDUCING THE POLLUTION FROM LAND APPLICATION AREAS,
Soil Conservation Service, Rutherfordton, NC.
For primary bibliographic entry see Field 5G.
W80-06622

FINITE ELEMENT ANALYSIS OF EFFLUENT FLOW FROM SUBSURFACE SEWAGE DISPOSAL FIELDS,
Minnesota Univ., St. Paul.
For primary bibliographic entry see Field 5D.
W80-06623

OXYGEN EXCHANGE BETWEEN A 'MODEL' POND AND THE ATMOSPHERE,
Science and Education Administration, Durant, OK. Southern Plains Watershed and Water Quality Lab.
O. R. Lehman.
Advances in Water Resources, Vol 2, No 2, p 87-89, June 1980. 2 Fig, 2 Tab, 15 Ref.

Descriptors: *Oxygen, *Dissolved oxygen, *Ponds, *Model studies, Atmosphere, Air, Mixing, Winds, Rainfall, Precipitation(Atmospheric), Temperature, Water temperature, Water quality, Nutrients, Oxygen exchange, Exchange rates.

Oxygen exchange between a sheltered 'model' farm pond (6 m diameter and 2.5 m deep) and the atmosphere averaged 0.33 m/day for measurements made from April to December. This value was similar to those reported for isolated surfaces in sheltered waters and in laboratory tanks but below those of large, inland waters. Low average wind velocity (0.7 m/sec) probably caused the low 02 exchange rate. Interactions between air and water temperatures and precipitation may be important factors governing short-term 02 exchange in highly sheltered waters. (Sims-ISWS)
W80-06625

A NOTE OF THE PERFORMANCE OF A 82BR RADIOACTIVE TRACER IN THE RIVER SKERNE, ENGLAND,
Teesside Polytechnic, Middlesbrough (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W80-06629

CHEMICAL YIELDS IN RUNOFF, AND DENUDATION IN A SMALL ARABLE CATCHMENT, EAST DEVON, ENGLAND,
Lanchester Polytechnic, Coventry (England). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W80-06633

THE FATE OF TRACE METALS IN NARRAGANSETT BAY, RHODE ISLAND: RADIOTRACER EXPERIMENTS IN MICROCOSMS,
Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 2L.
W80-06654

GROUND-WATER GEOCHEMISTRY: ARSENIC IN LANDFILLS,
Robert S. Kerr Environmental Research Lab., Ada, OK.
A. W. Hounslow.
Ground Water, Vol 18, No 4, p 331-333, July-August 1980. 1 Fig, 10 Ref.

Descriptors: *Arsenic compounds, *Landfills, *Groundwater, *Geochemistry, *Dissolved oxygen, Hydrogen sulfide, Iron compounds, Toxicity, Leachate, Infiltration, Aerobic conditions, Anaerobic conditions, Oxidation-reduction potential, Arsenate, Arsenite.

Three key hyrogeochemical environments based on the oxidation-reduction state of groundwater were defined by the presence or absence of dissolved oxygen and hydrogen sulfide. The mobility of arsenic is greatly influenced by these dissolved gases and the behavior of iron in these same environments. The main forms of arsenic in aqueous environments are arsenate and arsenite. Arsenate occurs in oxygenated waters, but if colloidal ferric hydroxide is also present, the arsenate may be adsorbed and removed from solution. In strongly reducing waters containing hydrogen sulfide arsenic is removed from solution and precipitated either as arsenic sulfide, heavy-metal sulfarsenite compounds, or co-precipitated with iron sulfides. In mildly reducing waters lacking both dissolved oxygen and hydrogen sulfide, arsenic occurs as the arsenite ion. In waters of this type the mobility of both arsenic (as arsenite) and iron (as ferrous iron) are at a maximum. It was also stressed that arsenite is 60 times more toxic to humans than arsenate. (Visocky-ISWS)
W80-06680

PHYSICOCHEMICAL TRANSFORMATIONS WITHIN EPHEMERAL STREAMBEDS RELATED TO SEWAGE EFFLUENT RELEASES,
Arizona Water Resources Research Center, Tucson.
R. A. Phillips, L. G. Wilson, and P. G. Sebenik.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-106700, Price codes: A04 in paper copy, A01 in microfiche. Project Completion Report, June 1977. 47 p, 17 Fig, 7 Tab, 22 Ref. OWRT-A-040-ARIZ (2), 14-31-0001-4003.

Descriptors: *Emphemeral streams, *Open channel flow, *Physicochemical properties, *Sewage effluents, Waste Water(Pollution), Water Quality, *Path of pollutants, Sampling, Water analysis, Nitrification, *Arizona, Santa Cruz River(AZ).

Hydraulic and physicochemical measurements were made on treated sewage effluent releases at established locations within the channel of an ephemeral stream, the Santa Cruz River of Southern Arizona. Water quality samples were taken in sequence so that incremental flows at different hydrograph stages could be traced as the effluent moved downstream. Hydrographs obtained from two H-L flumes were used to calibrate a modified kinematic wave model. Hydraulic parameters from the kinematic model and physicochemical measurements from water quality samples were combined together into a statistical-empirical kinetic model of nitrogen transformations which may occur in sewage effluent releases. There was fair agreement between the measured data and nitrogen species values calculated with the model. Measured nitrogen species values indicated that the rate of nitrification in sewage effluent releases is related to flow distance and physical characteristics of the stream.
W80-06695

NATAL SHELF CIRCULATION REVEALED BY LANDSAT IMAGERY,
National Physical Research Lab., Pretoria (South Africa).

O. G. Malan, and E. H. Schumann.
South African Journal of Science (Johannesburg), Vol 75, No 3, p 136-137, 1979. 3 Fig, 4 Ref.

Descriptors: *Ocean circulation, *Satellites(Artificial), *Remote sensing, *Coasts, *South Africa, Water circulation, Movement, Winds, Mixing, Diffusion, Mapping, Data collections, Synoptic analysis, Charts, Regions, *Pollutant identification, Surveys, Sediments, Meteorology, Suspended solids, Rivers, Industrial wastes, Tides, Eddies, Plankton, Measurement, Evaluation.

The circulation features of the Natal, South Africa, coastal area between 28 degrees S and 31 degrees S were analyzed by Landsat imagery. The images from two bands of the Landsat multispectra scanner (MSS) revealed patterns due to suspended particulate matter such as sediment, plankton, and antropogenic effluent, emanating from Lake St. Lucia/Mfolozi, Richards Bay, Tugela, Mvoti, Durban Bay, and Mkomazi. Plumes of industrial effluent appeared as gray patches on the black background, which is clear water. River-borne water containing particulate matter after heavy rains can be easily traced by the Landsat pictures. Eddy and current direction in Durban Bay can be mapped by snyoptic pictures of the area. Satellite imagery can map and qualitatively assess a large area of ocean depending on the weather, but conventional oceanographic measurements are necessary to quantify the ocean environment. (Sidney-IPA)
W80-06721

THE TSESIS OIL SPILL. REPORT OF THE FIRST YEAR SCIENTIFIC STUDY (OCTOBER 26, 1977 TO DECEMBER, 1978).
National Oceanic and Atmospheric Administration, Boulder, CO. Office of Marine Pollution Assessment; Stockholm Univ. (Sweden). Asko Lab.; and Swedish Water and Air Pollution Research Inst., Stockholm.
NOAA, Outer Continental Shelf Environmental Assessment Program Report, March 1980. 307 p.

Descriptors: *Oil spills, *Oil pollution, *Water pollution effects, Path of pollutants, Dispersion, Environmental effects, Biomass, Littoral, Benthos, Fish, Shellfish, Plankton, Birds, Crustacea, *Sweden, *TSESIS oil spill, Outer Continental Shelf, Oil transport, Pelagic system.

On October 26, 1977, the Soviet tanker TSESIS struck a rock in the fairway while inbound through the archipelago off Sodertalje, Sweden (northern Baltic Proper) releasing about 1100 tons of oil, mostly No. 5 fuel oil and some bunker oil. Cleanup operations recovered most of the oil. The area was one which had been relatively well studied in the past as the site of several marine biological programs and the spill study was initiated rapidly enough to have some littoral sites surveyed immediately before impact by oil making an 'ideal' oil study. The direct effects on the plankton included decreased zooplankton biomasses in the immediate vicinity of the tanker. Damage to bird life and the littoral zone was alleviated by the season of the spill. The supralittoral zone showed little damage when surveyed the following summer. In the littoral zone, no effects on the algae were seen, but the fauna of the most heavily oiled coastline showed direct effects. Crustaceans were especially hard hit, but less than a year later, recovery was well underway. Sediment traps deployed in the area demonstrated that oil was rapidly transported to the benthos. The recovery of the deep soft bottoms proved slower than for other systems studied. Chemical analysis showed rapid weathering of the TSESIS oil and all oil found in either biota or in sediment trap material was altered in composition, but identifiable as TSESIS oil. (See W80-06739 through W80-06752). (NOAA)
W80-06738

ESTUARINE SEDIMENTS: SUCCESSIONAL MODEL,
Oregon State Univ., Corvallis. Dept. of Civil Engineering.
K. J. Williamson, and D. A. Bella.
Journal of the Environmental Engineering Division, American Society of Civil Engineers, Vol 106, No EE4, Proceedings Paper 15595, p 695-710, August 1980. 11 Fig, 20 Ref, 2 Append. NSF ENV71-01908-A03.

Descriptors: *Sediments, *Estuaries, *Water pollution, *Model studies, Mathematical models, Iron, Sulfides, Sulfates, Bacteria, Toxins, Water quality, Chemicals, Chemical reactions, Benthos, Sedimentology, Estuarine sediments.

Estuarine sediments were discussed with emphasis given to the sulfur cycle. Human activities alter estuarine sediments, and adverse impacts can result. Toxic levels of free sulfide can build up within estuarine sediments, and hydrogen sulfide can be released to the atmosphere. A conceptual model was presented that can serve as a practical basis for monitoring estuarine sediments and for interpreting results. Methods for classifying estuarine sediments with a minimal amount of field effort were discussed. The model and methods presented allow description of changes in sediment characteristics in response to different natural and human imposed conditions. Experimental results were presented and discussed. (Sims-ISWS)
W80-06757

BUILDUP, STRENGTH, AND WASHOFF OF URBAN POLLUTANTS,
Illinois State Water Survey, Urbana.
M. L. Terstriep, G. M. Bender, and D. J. Benoit.
Journal of the Technical Councils of the American Society of Civil Engineers, Vol 106, No TC1, Proceedings Paper 15620, p 73-91, August 1980. 8 Fig, 6 Tab, 5 Ref, 2 Append.

Descriptors: *Water quality, *Urban runoff, *Sampling, *Mathematical models, *Illinois, Cities, Roads, Pollutants, Path of pollutants, Water pollution, Water pollution sources, Storms, Storm water, Data collections, Analytical techniques, Urbanization, Hydrology, Environmental engineering.

A study performed to satisfy the requirements of Section 208 of Public Law 92-500 for the nondesignated urban area of Illinois was described. The data collection program involving up to 34 constituents on both water samples and dry accumulation samples was summarized. The data were used to calibrate an urban runoff, quantity-quality model known as QUAL-ILLUDAS. The accumulation rates and composition of street surface pollutants needed in the model were determined. Model results were related to land use and other basin parameters by means of regression equations. It was concluded that water quality modeling is a useful tool and that urban runoff contains heavy metals and other constituents in excess of Illinois Water Quality Standards. (Sims-ISWS)
W80-06758

STORMWATER QUALITY--FIRST EFFORTS IN DENVER,
Urban Drainage and Flood Control District, Denver, CO.
B. Urbonas, and L. S. Tucker.
Journal of the Technical Councils of the American Society of Civil Engineers, Vol 106, No TC1, Proceedings Paper 15621, p 53-71, August 1980. 6 Fig, 8 Tab, 4 Ref, 2 Append.

Descriptors: *Water quality, *Urban runoff, *Storm water, *Sampling, Water pollution, Water pollution sources, Pollutants, Chemicals, Bacteria, Coliforms, Biochemical oxygen demand, Nitrogen, Heavy metals, Drainage, Drainage systems, Cities, Storms, Hydrology, *Denver(CO).

A sampling program for nonpoint source pollutants was initiated in Denver, in 1975. Some of the data collected and preliminary findings were presented. Tentative conclusions drawn on limited data from three watersheds were: (1) first-flush effects of storm runoff were not evident, and pollutant loadings generally followed the hydrograph throughout the runoff period; (2) there was a vague indication that longer antecedent dry periods lead to higher pollutant loads in subsequent runoff, but there were exceptions to this as well; and (3) in comparison with secondary effluent in the same watersheds, storm runoff gave much lower mass loadings to the receiving waters for all constituents except metals. Zinc loadings were two to four times higher than in secondary effluent, and lead was sometimes 10 to 20 times higher. Data collection programs of this type should be accompanied by immediate data analysis and evaluation, possible to include computer modeling, to redirect further sampling. (Sims-ISWS)
W80-06759

URBAN RUNOFF QUALITY: INFORMATION NEEDS,
Sonnen (M.B.) Co., Inc., Walnut Creek, CA.
M. B. Sonnen.
Journal of the Technical Councils of the American Society of Civil Engineers, Vol 106, No TC1, Proceedings Paper 15611, p 29-40, August 1980. 2 Tab, 24 Ref, 1 Append.

Descriptors: *Water quality, *Urban runoff, *Research and development, *Planning, Sampling, Runoff, Storm runoff, Cities, Land use, Urbanization, Pollutants, Water pollution, Water pollution sources, Mathematical models, Computer models, Information needs.

Current perceptions of runoff water quality viewed by government and by university and private scientists tend to be limited to immediate and pressing regulatory requirements. As a consequence, the true importance or insignificance of urban runoff as a source of damaging pollution is going undiscovered. Current mathematical models purporting to be theoretically sound expressions of urban runoff and land surface behavior were shown to be quite rudimentary, based on statistically invalid information, and are of questionable predictive value. Newer planning methods are needed on which to base decisions about costly pollution control alternatives. These methods can be forthcoming only through derivation of more comprehensive theory and by its proof in turn by more comprehensive sampling. Many information gaps, which were considered, should be filled. Limited, though perhaps still quite expensive, pilot programs of sampling were proposed. (Sims-ISWS)
W80-06760

FLOW-DRIVEN WATER QUALITY SIMULATION MODELS,
Severn-Trent Water Authority, Birmingham (England).
M. S. Farrimond, and J. A. R. Nelson.
Water Research, Vol 14, No 8, p 1157-1168, 1980. 7 Fig, 11 Tab.

Descriptors: *Water quality, *Flow, *Rivers, *Canals, *Model studies, Mathematical models, Simulation analysis, Computer models, Streamflow, Pumping, Water pollution, Water pollution sources, Pollutants, Path of pollutants, Biochemical oxygen demand, Chlorides, Ammonia, Nitrates, *River Severn(England), *England.

A method was presented for simulating the gross changes in river water quality which may result from natural variations in flow, systematic changes to the flow regime as a whole, or major changes in discharge quality. The mathematical model described, once calibrated, requires historic flow data which cover the range of conditions of interest; for example, a typical drought year. Applications were described in which the model was used on a desktop mini-computer to produce medium and long term predictions of river quality under a variety of flow regimes and to investigate the effects on water quality of a new reservoir. (Sims-ISWS)
W80-06771

THE EQUITABLE APPROACH TO POLLUTION CONTROL MANAGEMENT IN THE THAMES ESTUARY,
Metropolitan Pollution Control-Thames Water, London (England).
A. G. Cockburn, R. W. Griggs, and P. J. Lloyd.
Water Research, Vol 14, No 8, p 1119-1124, 1980. 5 Fig, 4 Tab, 5 Ref.

Descriptors: *Water pollution control, *Rivers, *Estuaries, *Management, Water pollution, Water pollution sources, Water quality, Water quality control, Sewage effluents, Industrial wastes, Storm runoff, Dissolved oxygen, Biochemical oxygen demand, Tidal waters, Planning, *Thames Estuary(England), *Thames River(England).

Wood and Cockburn outlined the theory of an equitable approach to pollution control. In order to use this approach, the pollution budget for the stretch of river must be defined, and this budget must be distributed equitably among the dischargers. The equitable approach assumes that all dischargers have an equal right to a share of the budget proportional to the potential load which would have been discharged were no treatment given. This paper extended the theory into practice and discussed some of the advantages and problems in the Thames Estuary. The dissolved oxygen pollution budget, based on quality objectives for the Thames, was defined and was distributed equitably among the dischargers. In setting the equitable allowances it is clear that other restraints prevent the freshwater rivers from using their full allowance, and this becomes available for other dischargers; further, it is difficult to properly ascribe allowances for nonpoint discharges and storm discharges. Because the setting of the pollution budget and the equitable approach use two different bases, they are not necessarily compatible, and therefore in the Thames a purely equitable approach would result in some failure to meet the objectives. A method for overcoming the problem was set out in the paper. When compatibility between equitability and the quality objectives has been achieved, required discharge standards can be calculated. (Sims-ISWS)
W80-06772

BEHAVIOUR OF 12 INSECTICIDES IN SOIL AND AQUEOUS SUSPENSIONS OF SOIL AND SEDIMENT,
Malaysian Agricultural Research and Development Inst., Selangor.
M. S. Sharom, J. R. W. Miles, C. R. Harris, and F. L. McEwen.
Water Research, Vol 14, No 8, p 1095-1100, 1980. 6 Fig, 4 Tab, 15 Ref.

Descriptors: *Behavior, *Insecticides, *Soils, *Sediments, Laboratory tests, Adsorption, Solubility, Pesticides, Organic pesticides, Chlorinated hydrocarbon pesticides, Pollutants, Path of pollutants, Water pollution, Agriculture, Agricultural chemicals.

The behavior of 12 insecticides in soil and aqueous suspensions of soil and sediment was studied in the laboratory. Insecticides used were representative of the organochlorine, organophosphorus, and carbamate groups. Tests were conducted using three soils and a stream sediment. The order of adsorption on soil was DDT greater than leptophos greater than dieldrin greater than endrin greater than ethion greater than chlorpyrifos greater than lindane greater than parathion greater than diazinon greater than carbaryl greater than carbofuran greater than mevinphos. Organic soil had the greatest adsorptive capacity greater than stream sediment greater than Beverly sandy loam greater than Plainfield sand. Desorption and mobility of the insecticides increased with increasing solubility of the insecticides in water, even though the insecticides tested were very different in chemical structure. The results indicated that adsorption, desorption, and mobility of insecticides in soil and water will be dependent to a large extent on the nature of the adsorbents and water solubility of the insecticides. (Sims-ISWS)
W80-06773

PERSISTENCE OF 12 INSECTICIDES IN WATER,
Malaysian Agriculture Research and Development Inst., Selangor.
M. S. Sharom, J. R. W. Miles, C. R. Harris, and F. L. McEwen.
Water Research, Vol 14, No 8, p 1089-1093, 1980. 4 Fig, 1 Tab, 24 Ref.

Descriptors: *Persistence, *Insecticides, *Aqueous solutions, Laboratory tests, Pesticides, Organic pesticides, Chlorinated hydrocarbon pesticides, Chemical degradation, Microbial degradation, Biodegradation, Pollutants, Path of pollutants, Water pollution, Agriculture, Agricultural chemicals.

The relative importance of chemical and biological processes in the degradation of 12 insecticides in water was studied by comparing their persistence in four types of water: natural, distilled, sterilized natural, and sterilized distilled. DDT, lindane, and parathion disappeared fairly quickly in the natural water, but were very persistent in the other types indicating the importance of microbial action in their degradation. There was little indication of chemical degradation of any of the organochlorine (OC) insecticides. The four compounds most stable in water were dieldrin, endrin (OCs), ethion, and leptophos (organo-phosphorus (OP) insecticides). Generally the other OP insecticides and both carbamates disappeared from all four types of water, demonstrating that chemical processes played a major role in their degradation, with biological processes having a secondary role for chlorpyrifos, diazinon, and carbaryl. The observed order of persistence after 8 weeks in natural water was dieldrin greater than endrin greater than ethion greater than leptophos greater than lindane greater than chlorpyrifos greater than diazinon greater than mevinphos greater than carbofuran greater than DDT greater than carbaryl greater than parathion. The random occurrence of the chemical types in this list demonstrates that generalization on persistence in the environment cannot be made on the basis of chemical structure. (Sims-ISWS)
W80-06774

ASPECTS OF THE AQUATIC CHEMISTRY OF CADMIUM AND ZINC IN A HEAVY METAL CONTAMINATED LAKE,
Rutgers-The State Univ., New Brunswick, NJ. Water Resources Research Inst.
B. K. Shephard, A. W. McIntosh, G. J. Atchison, and D. W. Nelson.
Water Research, Vol 14, No 8, p 1061-1066, 1980. 3 Fig, 4 Tab, 23 Ref. NSF GI-35106.

Descriptors: Lakes, Streams, *Water pollution, *Heavy metals, *Water chemistry, Sampling, Pollutants, Path of pollutants, Pollutant identification, *Cadmium, *Zinc, Ions, Dissolved solids, Suspended solids, Hardness(Water), Dissolved oxygen, Alkalinity, Hydrogen ion concentration, Oxidation-reduction potential, Chlorides, Sulfates, Water quality, Indiana, *Palestine Lake(IN), *Williamson Ditch(IN).

Concentrations of the heavy metals cadmium (Cd) and zinc (Zn) were determined at several sites in Palestine Lake, Indiana, and in the stream (Williamson Ditch) which transports metal-bearing wastes to the lake. Average dissolved Cd and Zn concentrations in the lake were as high as 17.3 micrograms/liter and 293 micrograms/liter, respectively, while corresponding suspended levels were 30.3 micrograms Cd/liter and 270 micrograms Zn/liter. Average levels of both Cd and Zn in the dissolved fraction exceeded those in the suspended fraction, except at one site in the lake where suspended Cd was higher. During anaerobic conditions occurring in lake's hypolimnion, a marked decrease in the dissolved fraction and concomitant increase in the suspended fraction of both Cd and Zn were noted. A cadmium-specific ion electrode was used to determine the chemical forms of dissolved Cd present in the lake. Free Cd(2+) was the dominant form; however, Cd-organic complexes sometimes comprised a significant portion of the total dissolved Cd. (Sims-ISWS)
W80-06775

HYDROLOGIC AND WATER-QUALITY APPRAISAL OF SOUTHEAST NASSAU COUNTY, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
H. F. H. Ku, and D. J. Sulam.
Nassau County Department of Public Works, Long Island Water Resources Bulletin 13, 1979. 129 p, 29 Fig, 14 Tab, 30 Ref, 2 Append.

Descriptors: *Water quality, *Groundwater, *Water pollution sources, *Sewerage, *New York, Aquifer characteristics, Water levels, Streamflow, Low flow, Pumping, Water wells, Water supply, Chemical analysis, Nitrates, Cesspools, Septic tanks, Long Island(NY), *Nassau County(NY), Surface-groundwater relationships.

A regional sewerage system under construction in southeast Nassau County is expected to affect ground-water levels, ground-water quality, and volume of streamflow. In the central part of the area to be sewered, nitrate (as N) concentrations in the water-table aquifer generally exceed 10 milligrams per liter (mg/L). Where the unsaturated zone exceeds 30 feet in thickness, almost all nitrogen species in water are in the form of nitrate. In the southern part of the area, where the unsaturated zone is thin, ammonium concentration is higher than elsewhere. In the southern part of an adjacent, sewered area, the average median concentration of ammonium (as N) is approximately 0.1 mg/L; in the unsewered area it is 2.4 mg/L. The higher dissolved-oxygen concentration in the sewered area is attributed to the interception of sewage by sewers. Streamflow characteristics in the sewered area indicate that sewerage has significantly reduced streamflow; similar reductions are expected in the unsewered area after the completion of sewerage. In the sewered area, median nitrate (as N) concentration of streamflow is 1.7 mg/L, whereas in the unsewered area, it is 6.6 mg/L. (USGS)
W80-06805

THE RELATIVE SIGNIFICANCE OF U.S. INDUSTRIAL HEAVY METAL LOADS TO THE GREAT LAKES,
Great Lakes Basin Commission, Ann Arbor, MI.
R. A. C. Sullivan, D. J. Scheflow, and W. C. Sonzogni.
Great Lakes Environmental Planning Study Contribution No 16, May 1980. 42 p, 6 Tab, 13 Ref.

Descriptors: Industrial water, *Wastewater pollution, *Great Lakes, Metals, *Heavy Metals, Point Source Pollution, *Industrial wastes, Industrial effluents, Water pollution, Water quality control, Evaluation.

Information on late 1970's loadings of heavy metals obtained from Michigan and Wisconsin industrial sources reveals that, when compared with inputs from other sources, industrial inputs are relatively small. The heavy metals load from Michigan and Wisconsin industrial sources is only slightly less than the loadings estimated for the states' municipal sewage treatment facilities (mid-1970's conditions). In the future, the industrial load will likely become more significant, relative to the municipal input, as phosphorus removal techniques come online or are upgraded at the major plants, and as industrial pretreatment requirements are implemented. The metals load contributed by Michigan and Wisconsin industries was determined to be substantially less than the load estimated to be contributed by atmospheric deposition to Lakes Superior, Michigan, Huron and Erie. With the exception of copper loading to Lake Erie, estimates of metals loading from urban and rural runoff in Michigan and Wisconsin are consistently greater than metal loads from these states' industrial sources. With the exception of Lake Erie, the average annual lead input to the lakes from shoreline erosion is greater than the total load from both municipal and industrial point sources in Michigan and Wisconsin.
W80-06816

NEAR FIELD MIXING OF STAGED DIFFUSER,
Delaware Univ., Newark. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W80-06819

HEXACHLOROBENZENE: ITS VAPOR PRESSURE AND VAPOR PHASE DIFFUSION IN SOIL,

California Univ., Riverside. Dept. of Soil and Environmental Sciences.
W. J. Farmer, M. S. Yang, J. Letey, and W. F. Spencer.
Soil Science Society of America Journal, Vol 44, No 4, p 676-680, July-August 1980. 7 Fig, 2 Tab, 15 Ref. EPA 68-03-2014.

Descriptors: *Industrial wastes, *Vapor pressure, *Soil properties, *Laboratory tests, Soil water, Diffusion, Soil science, Porosity, Organic compounds, Analytical techniques, Methodology, Testing procedures, Soil density, Data collections, Thermal properties, Temperature, Instrumentation, Hexachlorobenzene, Heat of vaporization.

Hexachlorobenzene (HCB) is of interest because large quantities are produced as a byproduct of the chlorinated solvent industry. Land disposal is one means of handling this industrial waste. Hexachlorobenzene is chemically stable, resistant to microbial decomposition, nearly insoluble in water, and has a moderate vapor pressure. Therefore, HCB will move in soils primarily by vapor phase diffusion. Negligible transport in moving water will take place. The vapor pressure of HCB, measured with the gas saturation technique, was related to the temperature by the equation log p = 12.94 - (5279/T) giving HCB vapor pressure values from 0.0000042 to 0.000224 mm Hg over the temperature range 15 to 45 C. The heat of vaporization of HCB was calculated to be 24.2 kcal/mol. Vapor pressure data were used to measure the vapor phase diffusion of HCB in soil using a vapor-diffusion cell. The steady-state vapor diffusion of HCB in soil was directly related to soil air-filled porosity and was therefore greatly reduced by increased soil bulk density and increased soil water content. The apparent steady-state HCB diffusion coefficient was linearly related to the soil porosity term. The calculated diffusion coefficient in air for HCB was 10,000 sq cm/day. (Humphreys-ISWS)
W80-06836

FACTORS INFLUENCING OXYGEN CONSUMPTION RATES IN FLOODED SOILS,
Agricultural Research and Education Center, Sanford, FL. Inst. of Food and Agricultural Sciences.
For primary bibliographic entry see Field 2G.
W80-06838

UPWELLING IN A NEARSHORE MARINE ECOSYSTEM AND ITS BIOLOGICAL IMPLICATIONS,
Cape Town Univ. (South Africa). Dept. of Zoology.
For primary bibliographic entry see Field 2L.
W80-06847

SEEPAGE FLOW IN EXTREMELY THIN AQUIFERS,
Bochum Univ. (Germany, F.R.). Inst. fuer Konstrucktiven Ingenieurban.
For primary bibliographic entry see Field 2G.
W80-06867

FINITE ELEMENT SOLUTIONS FOR UNCONFINED AQUIFER POLLUTION FROM SURFACE RECHARGE,
James Cook Univ. of North Queensland, Townsville (Australia).
R. E. Volker, I. A. Dawson, and V. Guvanasen.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 2.137-2.146, 1980. 4 Fig, 2 Tab, 12 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Water pollution, *Aquifers, *Recharge, *Model studies, Mathematical models, Finite element analysis, Groundwater, Groundwater movement, Pollutants, Path of pollutants, Laboratory tests.

Pollution of groundwater can occur under a wide variety of conditions and may require consideration of factors such as saturated or unsaturated flow, conservative on nonconservative contaminants, and the effect of contaminant concentration on fluid properties. The work that was described in this paper involved the movement of a conservative contaminant in saturated unconfined flow where the density of the fluid is dependent upon contaminant concentration. Pollution originates from a surface water source recharging the unconfined aquifer at the water table, and the recharge source is assumed to be long enough for two-dimensional flow to occur in a vertical section of the aquifer. Mass transport in the unsaturated zone was assumed negligible. This paper gave results obtained from a finite element model and included some experimental results for comparison purposes. (See also W80-06858) (Sims-ISWS)
W80-06874

AN EXPANDED SOLUTE TRANSPORT MODEL FOR SIMULATING GROUNDWATER CONTAMINATION EPISODES,
Notre Dame Univ., IN. Dept. of Civil Engineering.
A. A. Jennings, J. W. Male, and D. D. Adrian.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 2.147-2.156, 1980. 3 Fig, 6 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Water pollution, *Industrial wastes, *Chemicals, *Solutes, *Model studies, Mathematical models, Soil contamination, Soil water, Soil water movement, Pollutants, Path of pollutants, Groundwater, Solute transport.

Contaminants escaping from industrial waste disposal sites pose a serious threat to our subsurface water resources. Many past chemical disposal schemes were ill-considered, and current land disposal practices are less than ideal. The magnitude and eventual consequences of these practices are just beginning to make their full presence felt. The analysis of subsurface contamination by industrial chemicals intensifies the difficulties innate to groundwater quality simulation. Very high concentrations of acids, bases, and aqueous or nonaqueous solutions carrying hosts of trace constituents have been found escaping to the subsurface. Concentrations are often extreme enough to alter the physical properties of any water they burden. Furthermore, because of the diversity and sophistication of industrial chemcials, there is always great potential for interactions between solutes, and among these and the solid phase. To aid in the analysis of chemical contamination episodes, an experimental simulation was developed. This was posed as a coupled system of models to simultaneously resolve for solvent transport, solute transport, and solid phase mass accumulation. The model was designed to accommodate anisotropy and inhomogeneity with respect to both solvent conductivity and solute attenuation capacity. All physical properties were treated as functions rather than constants and a very general system of boundary conditions has been provided. (See also W80-06858) (Sims-ISWS)
W80-06875

COLLOCATION FORMULATIONS FOR THE FINITE ELEMENT ANALYSIS OF TIDAL AND TRANSPORT PROCESSES IN ESTUARIES,
Hanover Univ. (Germany, F.R.). Inst. of Structural and Numerical Mechanics.
For primary bibliographic entry see Field 2L.
W80-06877

MODELLING OF LANDFILL LEACHATE MIGRATION,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
J. F. Sykes, and G. J. Farquhar.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 2.249-2.259, 1980. 5 Fig, 7 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Leaching, *Leachate, *Landfills, *Model studies, Mathematical models, Finite element analysis, Numerical analysis, Simulation analysis, Groundwater, Groundwater movement, Pollutants, Path of pollutants, Water pollution, Soil contamination, Adsorption, Biodegradation, Chemical oxygen demand.

Research in recent years has seen the development of many mathematical models capable of the analysis of flow and contaminant transport in porous media. In this study, the data base developed for the Canadian Forces Base (CFB) Borden landfill site was used to develop a deterministic modeling procedure for the analysis of contaminant migration. The model used was based on the finite element method and was capable of the analysis of both conservative and attenuating species in variably saturated cross-sections as well as two-dimensional plan domains. Leaching and the attenuation processes of biodegradation and adsorption were modeled. (See also W80-06858) (Sims-ISWS)
W80-06884

A FINITE ELEMENT MODEL INCORPORATING CHARACTERISTICS FOR THE DIFFUSION-CONVECTION EQUATION,
British Columbia Univ., Vancouver.
E. Varoglu.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol.), Mississippi University, Oxford, May 19-23, 1980. p 3.3-3.19, 1980. 9 Fig,21 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Fluid mechanics, *Diffusion, *Convection, *Model studies, Mathematical models, Finite element analysis, Flow, Streamflow, Pollutants, Path of pollutants, Water pollution, Air pollution, Mass transfer, Heat transfer, Mixing, Analytical techniques, Diffusion-convection equation.

In recent years, numerical solutions of the diffusion-convection equation have attracted considerable attention due to the increasing interest in simulation of mass and heat transport phenomena in fluid mechanics. Various methods based on finite differences in space and time and a combination of finite elements in space and finite differences in time for solving the diffusion-convection equation are available in the literature. For several conventional finite element solutions, it has been demonstrated that neither higher order finite elements nor higher order integration-schemes in time eliminate the numerical difficulties encountered in convection-dominated flow problems. A new finite element method has been developed for the solution of the diffusion-convection equation in one-space dimension which, in the limit, will degenerate into efficient solutions for either the pure convection problem or the pure diffusion problem. The method employs space-time elements with edges joining the nodes at subsequent time levels oriented along the characteristics of the associated pure convection equation. In this paper in order to facilitate the understanding of the basic ideas, a discussion of the method for the diffusion-convection equation in one-space dimension, together with the generalization of the method into two-spatial dimensions were presented. The accuracy and utility of the method were demonstrated by solving two examples, and some of the numerical results were compared with the exact solutions. (See also W80-06858) (Sims-ISWS)
W80-06886

ALTERNATING DIRECTION COLLOCATION SOLUTION TO THE TRANSPORT EQUATION,
Princeton Univ., NJ. Dept. of civil Engineering.
M. A. Celia, G. F. Pinder, and L. J. Hayes.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol.), Mississippi University, Oxford, May 19-23, 1980. p 3.36-3.48, 1980. 5 Fig, 6 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Diffusion, *Convection, *Path of pollutants, *Model studies, Mathematical models, Equations, Finite element analysis, Mathematics, Numerical analysis, Computer models, Computer programs, Analytical techniques, Transport equation.

The purpose of this paper was to present an efficient numerical scheme for the solution of the multidimensional convective-diffusive transport equation. The scheme incorporated the computational efficiency of an orthogonal collocation approximation and an alternating direction solution procedure. The collocation method of numerical solution has been widely used in chemical engineering, where the governing equations are often strongly nonlinear. Recently Frind and Pinder and Pinder, Frind, and Celia have applied the collocation method in conjuction with an isoparametric finite element formulation. They reported a significant reduction in equation generation time, as compared with a Galerkin formulation of comparable accuracy. However, while the collocation equations could be formulated much more quickly, the solution time for the resulting matrix problem tended to be similar to that for the Galerkin formulation. Thus, if the solution time is significantly greater than the equation setup time, the advantages of the collocation finite element scheme become marginal. While the convergence properties of this new scheme have been demonstrated, it was the purpose of this paper to examine the computational efficiency of this alternating direction scheme when applied to the convective-diffusive transport equation. This was accomplished through a comparative examination of both the execution time and computer storage requirements for ADC and Galerkin finite elements using linear triangles. (See also W80-06858) (Sims-ISWS)
W80-06888

A FINITE ELEMENT SOLUTION OF THE ONE-DIMENSIONAL DIFFUSION-CONVECTION EQUATION,
Government of Costa Rica, San Jose.
E. Blair, and J. M. Wiggert.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol.), Mississippi University, Oxford, May 19-23, 1980. p 3.77-3.87, 1980. 9 Fig, 7 Ref. Science and Education Adminstration, New Orleans, LA.

Descriptors: *Convection, *Diffusion, *Mathematical studies, *Finite element analysis, Analytical techniques, Analysis, Mathematics, Equations, Mathematical models, Path of pollutants.

The evaluation of pollution levels in natural channels has been accomplished through the normal laboratory practices together with empirical and closed form approximations to the diffusion-convection equation. The diffusion-convection equation in its generalized one-dimensional form represents a specific process, in order: (1) the time variation, (2) the variation due to the flow, (3) the dispersion effects, (4) the variations due to reactions with and/or within the system, (5) the variations due to nonpoint sources (distributed), and (6) the variations due to concentrated sources. Several attempts have been made to find a numerical solution to the diffusion-convection equation through various methods. The finite element formulation used in this paper was based on one-dimensional elements; hence, the stream or estuary is simulated by a series of line elements. The one-dimensional element was chosen for simplicity and ease in handling, but its choice means that dispersion characteristics in the longitudinal direction are the only ones considered. The finite element method of solution agrees very well with the closed form solutions for certain situations. The method was successful in the following cases for the linear model: (1) steady and unsteady state solutions, (2) steady and unsteady state solutions without including the point and nonpoint source terms, (3) steady state situation of spatially varied flow, and even though oscillations became obvious, their magnitude was negligible and the true solution could easily be approximated, (4) steady state solution for the point and nonpoint discharges, (5) solution of the unsteady state instantaneous discharge of pollution, and (6) solution for a stream with tributaries, where acceptable answers were found for highly idealized conditions. (See also W80-06858) (Humphreys-ISWS)
W80-06890

EFFECTIVE AND HIGHLY ACCURATE SOLUTION OF DIFFUSION AND CONVECTION-DIFFUSION PROBLEMS USING MOVING, DEFORMING COORDINATES,
Cold Regions Research and Engineering Lab., Hanover, NH.
K. O'Neill, and D. R. Lynch.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol.), Mississippi University, Oxford, May 19-23, 1980. p 3.67-3.76, 1980. 6 Fig, 11 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Convection, *Diffusion, *Mathematical studies, *Finite element analysis, Analytical techniques, Analysis, Mathematics, Equations, Mathematical models, Path of pollutants.

A method was presented for dealing with diffusive or convective-diffusive type problems by formulating the equations in a moving, deforming numerical coordinate system. Hermite finite elements were utilized in one space dimension with finite difference in time, although the method may also be used with finite difference in space. Numerical coordinate motion was accounted for directly in the governing equations, so that the mesh may flow along with and be concentrated in regions of high activity, while being stretched out where attention is less needed. Mesh movement may be arbitrarily heterogeneous in space and time, so that one may leave fixed boundaries mathematically fixed. In the cases investigated, the moving mesh system was programmed with only a trivial increase in complexity relative to a fixed grid approach. Great accuracy and efficiency resulted, with no oscillations in problems which suffered significantly from this difficulty when treated by otherwise comparable fixed grid approaches. Nothing in the basis of the method limits it to linear or one-dimensional applications. (See also W80-06858) (Humphreys-ISWS)
W80-06891

IDENTIFICATION OF PARAMETERS IN A CONVECTION-DIFFUSION EQUATION USING THE FINITE ELEMENT METHOD,
Louisiana State Univ., Baton Rouge. Dept. of Mechanical Engineering.
H. Sehitoglu.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol.), Mississippi University, Oxford, May 19-23, 1980. p 3.88-3.96, 1980. 5 Fig, 4 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Convection, *Diffusion, *Mathematical studies, *Finite element analysis, Analytical techniques, Analysis, Mathematics, Equations, Mathematical models, Algorithms, Path of pollutants.

This paper investigated the identification of parameters in a one-dimensional transport equation which described the state of a scalar quantity affected by the motion of a fluid (water, air, etc.). This partial differential equation, also known as the convection-diffusion equation, represents numerous engineering problems, some of which are: pollutant distribution in water and air, temperature variation in estuaries, motion of one 'colored' fluid in another fluid, etc. The use of this equation, however, requires the estimation of the physical parameters because they are usually unkown at the time of the application of the model due to various environmental influences. A finite element-equation error method was utilized in constructing the identification algorithm used in this study. It was shown that the use of the finite element method in connection with the error equation technique yields an efficient algorithm to identify the parameters in a convection-diffusion equation. The method requires measured output data at a number of locations in the spatial domain. Simulation runs have indicated that accuracy of the identification method generally increases as the distance between tow output nodes is reduced. (See also W80-06858) (Humphreys-ISWS)
W80-06892

SOME CONSIDERATIONS IN FINITE ELEMENT SOLUTIONS TO COUPLED GROUNDWATER FLOW AND CONVECTIVE-DISPERSION EQUATIONS,
Clemson Univ., SC. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2L.
W80-06893

FINITE ELEMENT METHODS IN TWO LAYER AND MULTI-LEVELED FLOW ANALYSIS,
Chuo Univ., Tokyo (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2L.
W80-06903

APPLICATION OF THE FINITE ELEMENT METHOD TO VERTICALLY STRATIFIED HYDRODYNAMIC FLOW AND WATER QUALITY,
Hydrologic Engineering Center, Davis, CA.
For primary bibliographic entry see Field 2H.
W80-06910

FINITE ELEMENT ANALYSIS OF THERMAL CONVECTION IN DEEP OCEAN SEDIMENTS,
Sandia National Labs., Albuquerque, NM. Heat Transfer and Fluid Mechanics Div.
For primary bibliographic entry see Field 2L.
W80-06927

CONVECTIVE HEAT TRANSPORT IN MERGING FLOWS,
Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.
For primary bibliographic entry see Field 2E.
W80-06928

5C. Effects Of Pollution

WATER QUALITY OF ROGERS LAKE, DAKOTA COUNTY, MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2H.
W80-06524

LARGE-SCALE OPERATIONS MANAGEMENT TEST OF USE OF THE WHITE AMUR FOR CONTROL OF PROBLEM AQUATIC PLANTS; REPORT 1, BASELINE STUDIES; VOLUME I: THE AQUATIC MACROPHYTES OF LAKE CONWAY, FLORIDA,
Florida Dept. of Natural Resources, Tallahassee. Bureau of Aquatic Plant Research and Control.
For primary bibliographic entry see Field 2I.
W80-06541

POLYCHLORINATED BIPHENYLS: ABSORPTION AND BIOACCUMULATION BY GOLDFISH (CARASSIUS AURATUS) AND INACTIVATION BY ACTIVATED CARBON,
North Carolina State Univ. at Raleigh. Weed Science Center.
P. J. Shea, H. J. Strek, and J. B. Weber.
Chemosphere, Vol 9, p 157-164, 180. 2 Fig, 3 Tab, 15 Ref. OWRT B-122-NC (2).

Descriptors: *Polychlorinated biphenyls, *Fish, *Retention, *Absorption, Pesticide residues, Water pollution sources, Laboratory tests, Carbon radioisotopes, Aroclors, Activated carbon, Water treatment, Sampling, Soil contamination, Path of pollutants, Sediments, Soil properties, Particle size, Time, Evaluation, Separation techniques, Adsorption, Goldfish.

The biological availability of PCB in soil sediment to goldfish (Carrasius auratus) was studied to determine the effects of time on PCB absorption and exudation and the deactivation of PCB by activated carbon. Goldfish were placed in six one-liter beakers in which sediment spiked with 14C-Aroclor 1254 had been added to two samples of contaminated soil and two samples of uncontaminated soil. Activated carbon was added to one of the contaminated and one of the uncontaminated soil samples and two replications of carbonless, unspiked soils were used as controls. Two goldfish

were placed in each of the beakers for 5 day periods beginning 1, 6, and 19 days after initially preparing the treatments. The 14C activity was measured in the homogenized portions of the head and internal organs followed by the activity of the muscle tissue. The fish was carefully swabbed to remove particulate matter and the background 14C activity of the sediment and water was measured. Activated carbon was found to be 90 to 100% effective in reducing the bioavailability of 14C-PCB to goldfish as measured in the muscle tissue. The greatest 14C-PCB uptake occurred in the first 24 hours in all tests and decreased thereafter probably due to settling of the contaminated sediment. The 14C-PCB levels in the fish in carbon treated systems leveled off after one day while it increased in the noncarbon-tested systems. About half of 14C activity in fish exposed for 5 days was lost when they were relocated to pure water for 5 days. (Sidney-IPA)
W80-06550

ALKANES IN BENTHIC ORGANISMS FROM THE BUCCANEER OIL FIELD,
Houston Univ., TX. Dept. of Biophysical Sciences.
B. S. Middleditch, and B. Basile.
Bulletin of Environmental Contamination and Toxicology, Vol 24, p 945-952, 1980. 1 Fig, 1 Tab, 10 Ref.

Descriptors: *Oil pollution, *Gulf of Mexico, *Benthos, Water pollution effects, Bottom sediments, Environmental effects, Resources development, *Outer Continental Shelf, *Alkanes, Pleuroploea giganta, Pteria colymbus, Hydroids, Buccaneer oil field.

Alkane profiles of 48 benthic organisms from the Buccaneer oil field are reported. Coral samples contained biogenic alkanes in the C22 to C32 region (Koons et al 1965). Hydroid specimens exhibited similar profiles which were also ascribed a biogenic origin. Samples of one species of mollusc, Pleuroploea giganta, from the production and quarters platforms contained petroleum alkanes, while corresponding samples from the well jacket did not contain these compounds. Some specimens of another mollusc, Pteria colymbus, contained petroleum hydrocarbons, while there was no evidence for petroleum hydrocarbons in any of the other species examined: Arbacia unctulata, Chloeia viridis, Murex fulvescens, Pagurus floridanus, and Fasciolaria hunteria. Mulluscs have been shown to sequester petroleum hydrocarbons after long periods of exposure. In the present study, however, petroleum alkanes were found only in Pleuroploea gigantea and Pteria colymbus, but even in these organisms such hydrocarbons were generally present in concentrations lower than those of the biogenic hydrocarbons. (Sinha-OEIS)
W80-06553

ULTRASTRUCTURAL EFFECTS OF CRUDE OIL ON EARLY LIFE STAGES OF PACIFIC HERRING,
Alaska Univ., Fairbanks. Inst. of Marine Science.
J. A. Cameron, and R. L. Smith.
Transactions of the American Fisheries Society, Vol 109, No 2, p 224-228, March 1980. 2 Fig, 8 Ref.

Descriptors: *Oil pollution, *Water pollution effects, Fish, *Herrings, Environmental effects, Resources development, Alaska, *Outer Continental Shelf, Clupea harengus pallasi, *Crude oil, Ultrastructural effects.

Eggs of Pacific herring, Clupea harengus pallasi, collected from Prince William Sound, Alaska were exposed to Prudhoe Bay crude oil for 4-144 hours, then returned to uncontaminated seawater for further development. Newly hatched larvae from both control and experimental groups showed no gross abnormalities. Fransmission electron microscopy revealed inter- and intracellular spaces in brain and muscle tissues of exposed organisms but not in those of controls. Many mitochondria in the body muscle of exposed organisms were swollen, some with deteriorating cristae structure. (Sinha-OEIS)
W80-06554

INFLUENCE OF TEMPERATURE, SALINITY, AND PHENANTHRENE (A PETROLEUM DERIVED POLYCYCLIC AROMATIC HYDROCARBON) ON THE RESPIRATION OF LARVAL MUD CRABS, RHITHROPANOPEUS HARRISII,
Texas A and M Univ., College Station. Dept. of Biology.
R. B. Laughlin, Jr., and J. M. Neff.
Estuarine and Coastal Marine Science, Vol 10, p 655-669, 1980. 9 Fig, 37 Ref.

Descriptors: *Water pollution effects, *Oil pollution, *Aromatic compounds, *Crabs, Respiration, Temperature, Salinity, Larvae, Environmental effects, *Outer Continental Shelf, Petroleum hydrocarbons, Polycyclic aromatic hydrocarbons, Phenanthrene, Sublethal dosages, Rhithropanopeus harrisii.

Loeal stages and the megalops stage of the mud crab, Rhithropanopeus harrisii were exposed to factorial combinations of salinity, temperature and chronic, sublethal concentrations of phenanthrene. Respiration rates were determined for second stage zoeae, fourth stage zoeae and for the megalops raised in the different factor combination. In general, respiration rates of temperature acclimated animals were relatively temperature-independent. All stages showed an increase in respiration rate a low salinities. This increase occurred for all stages tested, but was greatest in the earlier stages. Exposure to high sublethal concentrations of phenanthrene usually resulted in an increase in respiration rates over control rates. However, at low phenanthrene concentrations, the respiratory rate changes were not always dose dependent. Both the direction and magnitude of change from control rates appeared to be a function of age, prevailing physical factor regime, and level of hydrocarbon exposure. The interactive effects of temperature, salinity, and phenanthrene on growth were more consistent. The weight of controls increased with salinity. Animals exposed to phenanthrene consistently weighed less than controls and low-salinity, high phenanthrene combinations produced the smallest megalopae. It is hypothesized that at low salinities, decreased growth is caused by respiratory loss of carbon, and that high phenanthrene concentrations exacerbate this effect possibly by increasing the metabolic cost of osmo-regulation or increasing the rate of membrance turnover. (Sinha-OEIS)
W80-06555

ENVIRONMENTAL FACTORS IN APPLICATION OF LIQUID SLUDGE TO UPSTATE NEW YORK FARMLANDS,
Technical Completion Report State Univ. of New York at Binghamton. Dept. of Chemistry.
For primary bibliographic entry see Field 5E.
W80-06564

HYDROGEOLOGIC DATA FOR EUREKA SPRINGS LANDFILL AND ADJACENT AREA, NORTH-CENTRAL HILLSBOROUGH COUNTY, FLORIDA, 1969-73,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W80-06580

THE DISTRIBUTION OF THE POLYCHAETE CAPITELLA CAPITATA (FABRICIUS) IN DOCK SEDIMENTS,
Liverpool Polytechnic (England). Dept. of Biology.
C. J. James, and R. Gibson.
Estuarine and Coastal Marine Science, Vol 10, No 6, p 671-683, June 1980. 4 Fig, 5 Tab, 38 Ref.

Descriptors: *Benthic fauna, *Harbors, *Docks, *Sediments, Heavy metals, Organic compounds, Hydrogen sulfide, Organic matter, Sampling, Data processing, Distribution patterns, Water pollution, Water pollution sources, Pollutants, Water pollution effects, Benthos, Plankton, Water quality, Polychaeta, Macrofauna, *Liverpool(England).

The relationships between the distribution of the polychaete Capitella capitata, sediment type, total organic matter, hydrogen sulfide concentration, and heavy metal contamination in an enclosed polyhaline nontidal dock were reported. Capitella was most abundant in unstable coarse sediments characterized by low levels of organic and sulfide pollution and was found only in small numbers in stable silt-bearing substrates where high sulfide accumulation, together with large amounts of organic matter, was likely to lead to low oxygen availability. Heavy metal accumulations appeared to have no effect on the distribution of the polychaete. (Sims-ISWS)
W80-06655

EFFECTS OF HERBICIDES ON SUBMERGED SEED PLANTS,
Auburn Univ., AL. Dept. of Botany and Microbiology.
D. E. Davis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-103103, Price codes: A02 in paper copy, A01 in microfiche. Completion Report, September 15, 1980. 19 p, 15 Ref. OWRT-A-067-ALA (2).

Descriptors: *Herbicides, Effects, Underwater seed plants, *Submerged plants, *Toxicity, Plant growth, Elodea, Fanwort, Eurasian milfoil, Evaluation.

The effect of various concentrations of three herbicides on underwater seed plants was investigated. The herbicides used were atrazine (2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine)), glyphosate (N-(phosphono-methyl) glycine), and metribuzin (4-amino-6-tert-butyl-3-(methylthio)-as-triazin-5(4H)-one). The plants exposed to one or more of these herbicides were elodea (Elodea canadensis), wild-celery or vallisneria (Vallisneria americana), redheadgrass (Potamogeton perfoliatus), Eurasian watermilfoil (Myriophyllum spicatum), egeria (Egeria densa), fanwort or cabomba (Cabomba carolininiana), and milfoil (Myriophyllum sp.). Glyphosate was the least toxic of the three herbicides tested. The highest concentration tested, 320 parts per billion, did not significantly inhibit the growth of elodea or Eurasian watermilfoil.
W80-06685

THE EFFECTS OF TOXIC BLUE-GREEN ALGAE ON AQUATIC ANIMALS,
New Hampshire Univ., Durham. Dept. of Zoology.
For primary bibliographic entry see Field 5A.
W80-06687

EUTROPHICATION STRESS IN THE LITTORAL ZONE RESULTING FROM SHORELAND DEVELOPMENT,
Massachusetts Univ., Waltham. Dept. of Environmental Sciences.
H. B. Gunner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-103087, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Center, University of Massachusetts Publication No 116, 1980. 62 p, 12 Fig, 7 Tab, 92 Ref. OWRT-B-058-MASS (3), 14-34-0001-9076.

Descriptors: *Eutrophication, *Littoral, *Nutrients, *Macrophytes, Myriophyllum heterophyllum, *Nitrification, *Aquaticmicroflora distribution, *Shoreland development, Microbial rhizosphere, Rhizosphere population, Hydroxylamine release, Nitrifying Arthrobacter sp., Inhibition of Chlorella vulgaris.

Nutrient release by decomposing water milfoil tissue (Myriophyllum heterophyllum) and the changes attendant upon nitrification are primary determinants in the subsequent distribution and abundance of aquatic microflora. The death and decay of the macrophyte releases ammonia and phosphate in concentrations sufficient to promote algal growth. The oxidation of ammonia by resident nitrifiers exercises a striking impact on microfloral succession. Nitrification is accompanied by a decrease in pH and thereafter by a decline in the numbers of bacteria and protozoa. Subsequently,

coincident with the accumulation of nitrite and nitrate, the numbers of the resident green algal communities rise dramatically. Bacterial populations associated with the rhizosphere and rhizoplane of Myriophyllum heterophyllum were found to differ distinctly from that of the adjacent sediments. Higher populations of bacteria capable of nitrate reduction and ammonification occurred in the rhizoplane and nitrogen fixing (acetylene reducing) activity was significantly higher on the root surface than in the sediment. Higher populations of bacteria involved in nutrient transformations in the rhizoplane suggest that these have a greater potential for supplying aquatic plants with readily available nutrients than do the non-rhizosphere populations. The selective effects of nitrification were also found to be due to hydroxylamine released by a nitrifying Arthrobacter sp. which inhibited the growth of Chlorella vulgaris. Non-nitrifying bacterial isolates of lacustrine origin did not demonstrate inhibiting activity.
W80-06690

ACID MINE POLLUTION: EFFECTS ON SURVIVAL, REPRODUCTION AND AGING OF STREAM BOTTOM MICROINVERTEBRATES,
Ohio University, Athens, Dept. of Zoology.
W. D. Hummon.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-103079, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Center, Ohio State University, Columbus, Project Completion Report No RF 760851-710801, 1980. 72 p. OWRT-A-050-OHIO (3).

Descriptors: *Acid mine water, Effects, *Toxicity, *Benthos, *Aquatic microorganisms, *Invertebrates, Reproduction, Respiration, Animal physiology, Aging, Water pollution effects.

Warbug manometry was used to assess the effect of acid mine water on respiratory processes in three species of aquatic insect larvae. Field collections and laboratory toxicity tests indicated short longevity under strong acid mine conditions. Mixed results were found with respect to weight-dependent respiratory rates. Sequential respiration determinations, under control-control or control-treatment fluids, indicated that acid mine water did not consistently alter rates. Animals maintained in mine water until death showed gradual decreases in respiratory rates over time, rather than stepwise drops that would accompany ionic interference. For these species the toxic mode of action of acid mine water does not appear to operate through mechanisms that are detectable by respirometry.
W80-06693

DISTRIBUTION AND BUDGETS OF CARBON, PHOSPHORUS, IRON AND MANGANESE IN A FLOODPLAIN SWAMP ECOSYSTEM,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
E. J. Kuenzler, P. J. Mulholland, L. A. Yarbro, and L. A. Smock.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-103061, Price codes: A12 in paper copy, A01 in microfiche. Water Resources Research Institute, University of North Carolina, Raleigh, Report No 157, May 1980. 234 p, 47 Fig, 47 Tab. OWRT-B-110-NC (3), 14-34-0001-8105.

Descriptors: Wetlands, *Swamps, *Flood plains, *Nutrients, *Ecosystems, *Metals, Cycling nutrients, Phosphorus, Carbon, Iron, Manganese, Inflow, Rainfall disposition, Freshwater, *North Carolina, Bulk precipitation.

A freshwater floodplain swamp ecosystem, Creeping Swamp, on the lower Coastal Plain of North Carolina was the site of intensive, coordinated studies of system structure and functioning focused on organic carbon and phosphorus. The swamp, usually flooded in winter and early spring by darkly-colored water low in conductivity, pH, and plant nutrients, supports a typical deciduous hardwood bottomland forest. The investigations emphasized field measurements of the major compartments and of the dominant fluxes between these compartments in the natural swamp for two years. In addition the fluxes of carbon and phosphorus into and out of the swamp ecosystem were determined and material budgets were constructed. The abundances of iron and manganese in several physical and chemical forms in water and soils were also measured. Most of the organic C in the swamp ecosystem (22 kg.m-2) was present in living trees and saplings (63%), and almost all of the remainder occurred as swamp floor litter, logs, and soil organic matter (to 25 cm depth). Annual inputs to the swamp in 1977 amounted to 902 g C.M-2.yr-1 of which 21% was organic c in stream flows into the swamp and 77% was net primary productivity of trees, saplings, shrubs, and herbs. Most of the phosphorus in the swamp ecosystem (about 39 g P.m-2) was in the upper 25 cm of soil (86%), with the remainder mostly in above-ground vegetation. Annual P input to the ecosystem (1050-1290 mg P.m-2.yr-1) was carried predominantly by surface waters (94%), with bulk precipitation delivering the rest. Iron and manganese exist in swamp waters and soils in a large variety of physical and chemical forms which change in concentration through the year.
W80-06694

THE EFFECT OF ALGAL INHIBITORS ON HIGHER PLANT TISSUES,
Colorado State Univ., Fort Collins. Dept. of Botany and Plant Pathology.
P. Kugrens.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-102998, Price codes: A03 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute, Colorado State University Completion Report 98, July 1980, 26 p, 11 Fig, 25 Ref. OWRT-A-031-COLO (1), 14-34-0001-6006, 7011, 7012.

Descriptors: *Algal inhibitors, Effects, Higher plants tissues, *Irrigation water, *Algae, Reservoirs, Ponds, *Colorado, Bioassay, Plant growth, Growth rates, *Plant tissues.

Commonly-occurring algae in Colorado reservoirs and ponds were studied with regard to inhibitor production and their effects on higher plants. Seven algal genera that are abundant in Colorado irrigation waters were found to have significant effects on higher plants. The genera were Aphanizomenon, Microcystis, Nitzschia, Hydrodictyon, Scenedesmus, Lyngbya, and Anabaena. A rapid, sensitive bioassay system, using cultured radish cotyledons was developed to test the inhibitor effects. Growth was decreased significantly when compared to controls and in some cases resulted in necrotic areas on the leaf or death of the entire cotyledon. Cytological investigations with the electron microscope also revealed sub-cellular changes including retardation of protein body degradation, lack of starch formation, disruption of proper photosynthetic lamellar (thylakoid) formation in chloroplasts, decrease in cell size, and retardation of vascular tissue development. Depending on the specific alga, their inhibitors have multiple effects on higher plant tissues and in a natural system could stress the plant, thus increasing their susceptibility to pathogens.
W80-06697

THE TSESIS OIL SPILL. REPORT OF THE FIRST YEAR SCIENTIFIC STUDY (OCTOBER 26, 1977 TO DECEMBER, 1978).
National Oceanic and Atmospheric Administration, Boulder, CO. Office of Marine Pollution Assessment; Stockholm Univ. (Sweden). Asko Lab.; and Swedish Water and Air Pollution Research Inst., Stockholm.
For primary bibliographic entry see Field 5B.
W80-06738

LESSONS LEARNED FOR THE MANAGEMENT OF OIL SPILL INVESTIGATIONS,
Swedish Water and Air Pollution Research Inst., Stockholm.
O. Linden, R. Elmgren, L. Westin, and J. Kineman.
In: The TSESIS Oil Spill. Report of the First Year Scientific Study (October 26, 1977 to December 1978), p 20-26, March 1980. 3 Ref.

Descriptors: *Research priorities, *Oil spills, *Planning, *Management, Water pollution effects, Environmental effects, On-site investigations, Sampling, Surveys, Pollutant identification, Baltic Sea, Sweden, *Tsesis oil spill, *Outer Continental Shelf, International cooperation.

The Tsesis oil spill study was primarily an ad hoc planning effort, except for the fortunate existence of an ongoing marine science program. It was also a unique experience on the part of the local scientists involved--a typical situation for significant oil spills that have occurred to date. If the eventual transition is to be made from ad hoc planning to contingency management of events (including research) following the predictable and possibly larger future spills, a determination of important lessons to be learned from each incident is necessary. A number of these lessons, made apparent during the Tsesis study, are summarized for the purpose of improving future management of environmental investigations of oil spills. These lessons are: (1) Funding sources need to be identified in advance; (2) contingency research planning is needed; (3) further development is needed for sampling techniques; and (4) the scope of the scientific investigation must not be limited administratively. (See also W80-06738) (Sinha-OEIS)
W80-06739

IMPACT OF OIL ON THE PELAGIC ECOSYSTEM,
Stockholm Univ. (Sweden). Asko Lab.
S. Johansson.
In: The TSESIS Oil Spill. Report of the First Year Scientific Study (October 26, 1977 to December 1978), p 61-80, March 1980. 10 Fig, 2 Tab, 23 Ref.

Descriptors: *Oil spills, *Oil pollution, *Water pollution effects, *Ecosystems, Plankton, Sedimentation, Bacteria, Biomass, Environmental effects, Seasonal, *Outer Continental Shelf, Baltic Sea, Sweden, Pelagic ecosystems, *Tsesis oil spill.

Although the pelagic system was the first to suffer from the oil spill, the results from this study show only minor effects. Changes in species composition could not be detected either in the phytoplankton or the zooplankton community. The phytoplankton biomass almost certainly increased in the affected area. This is also true of bacterial abundance which may have been due to decreased zooplankton grazing or increased growth rate. No significant differences in zooplankton composition or biomass could be detected, except at station 2 immediately after the spill when two measurements from separate days showed a drastically lowered biomass. It is known, however, that zooplankton, when exposed to oil, either try to escape or enter a state of 'narcosis'. Either of these mechanisms could explain the very low biomasses near the wreck. Perhaps the most interesting results from the pelagial study were obtained from the sediment traps. During the first period of sediment trapping, very high amounts of oil (up to 0.7%) were recorded in the sedimented matter. Sedimentation of oil to the benthos was calculated to be at least 19 tons for the estimated affected area of 42 sq km. It was concluded that the effect on the pelagic system was moderate and of short duration - within one month all measured parameters were essentially normal. (See also W80-06738) (Sinha-OEIS)
W80-06740

NOAA ACUTE PHASE EXPERIMENTS ON PELAGIC AND SURFACE OIL,
National Oceanic and Atmospheric Administration, Boulder, CO. Office of Marine Pollution Assessment.
J. Kineman, and R. C. Clark, Jr.
In: The TSESIS Oil Spill. Report of the First Year Scientific Study (October 26, 1977 to December 1978), p 83-94, March 1980. 2 Fig, 2 Tab, 5 Ref.

Descriptors: *Oil spills, *Oil pollution, *Water pollution effects, Chemical analysis, Weathering Environmental effects, *Outer Continental Shelf, Pelagic oil, Baltic Sea, *Tsesis Oil Spill, Sweden.

The NOAA/OCSEAP Spilled Oil Research (SOR) Team objectives were limited to investigating the accommodation of oil in the water column below a contained oil slick, and subsequent downstream decay. Secondly, to determine downstream decay, the plan called for sampling at various depths in the water column, while following a parcel of water as a 'Lagrangian' drift study. The original plan also called for determining currents and extracting water samples in the field. Modifications were made to the original experiment design to adapt to existing conditions. It can be concluded that concentrations of Tsesis oil of 50 to 60 micro g/1 were observed by fluorescence at 1/2 and 1 m depths in low mixing energy conditions, below a captured slick which was fully emulsified and which had weathered for 2 to 5 days. This oil was most likely microdispersed particles from the surface mousse. The oil in the water column (as with the surface mousse) bore great similarity in composition with the cargo oil, except for slight losses of the lighter molecules. This similarity can be attributed to the rapid emulsification which retarded evaporative losses and other forms of physical weathering. (See also W80-06738) (Sinha-OEIS)
W80-06741

IMPACT OF OIL ON DEEP SOFT BOTTOMS,
Stockholm Univ. (Sweden). Asko Lab.
R. Elmgren, S. Hansson, U. Larsson, and B. Sundelin.
In: The TSESIS Oil Spill. Report of the First Year Scientific Study (October 26, 1977 to December 1978), p 97-126, March 1980. 14 Fig, 1 Tab, 35 Ref.

Descriptors: *Oil spills, *Oil pollution, *Water pollution effects, Environmental effects, Aquatic animals, Sediments, *Outer Continental Shelf, Baltic Sea, *Tsesis Oil Spill, Sweden, Macoma balthica, Halicryptus spinulosus, Pontoporiea affinis.

The Tsesis spill occurred in an area where benthic data have been collected since 1972. Pre-spill macrofauna data were already available, while meiofauna samples are stored and will be sorted later if funding becomes available. Considerable amounts of oil reached the sediment within a week at the most heavily affected stations, as shown by sediment trap data. After one month, oil analyses of Macoma balthica showed contaimination with oil at several widely separated stations. The macrofauna community responded drastically at station 20, and probable short-term effects were seen also at station 21. The vagile macrofauna, especially the amphipods died at or emigrated from the most affected station (No. 20). The few remaining gravid amphipods showed an increased frequency of abnormal eggs. No reduction in abundance or biomass was found in Macoma balthica or Halicryptus spinulosus. All meiofauna except the nematodes was drastically reduced at station 20 and a large kill of ostracods seem to have taken place relatively soon after the spill. In spite of these clear ecological effects, no Tsesis oil hydrocarbons could be conclusively demonstrated in the sediments, probably due to inadequate sampling methods. Neither the affected macrofauna, nor the meiofauna showed any evidence of recovering within the 9-10 month period after the spill so far studied. (See also W80-06738) (Sinha-OEIS)
W80-06742

IMPACT OF OIL ON THE LITTORAL ECOSYSTEM: EFFECTS ON FUCUS MACROFAUNA,
Swedish Water and Air Pollution Research Inst., Stockholm
M. Notini.
In: The TSESIS Oil Spill. Report of the First Year Scientific Study (October 26, 1977 to December 1978), p 129-145, March 1980. 7 Fig, 2 Tab, 14 Ref.

Descriptors: *Oil spills, *Oil pollution, *Water pollution effects, *Littoral, Aquatic animals, Algae, Seaweed, Environmental effects, Ecosystems, *Tsesis Oil Spill, *Outer Continental Shelf, Baltic Sea, Sweden, Fucus vesiculosus, Mytilus edulis, Theodoxus fluviatilis, Balanus improvisus, Macoma baltica.

The Tsesis ran aground in shallow, narrow waters and large amounts of th oil could not be prevented from reaching the nearby shores during the first hours and days. Therefore, extensive effects on the littoral communities could be predicted. A drastic decrease of the total Fucus macrofauna took place along the shore that was first hit by the oil spill. The abundance of all macrofauna species, with the possible exception of the barnacle Balanus improvisus, decreased during the acute phase at stations affected by the oil. The degree and duration of the damage varied at the different stations. This may be explained by the fact that the oil reached some stations 5 to 10 days after the oil spill. The data presented here clearly demonstrates drastic effects on the animal life of the Fucus community. On the other hand recolonization at several stations started soon after the acute phase. (See also W80-06738) (Sinha-OEIS)
W80-06743

IMPACT OF OIL ON THE LITTORAL ECOSYSTEM: EFFECTS ON THE PHYTAL ECOSYSTEM,
Stockholm Univ. (Sweden). Asko Lab.
H. Kautsky.
In: The TSESIS Oil Spill. Report of the First Year Scientific Study (October 26, 1977 to December 1978), p 146-161, March 1980. 3 Fig, 6 Tab, 13 Ref.

Descriptors: *Oil spills, *Oil pollution, *Water pollution effects, *Ecosystems, Aquatic plants, Seasonal, Environmental effects, Littoral, *Tsesis Oil Spill, *Outer Continental Shelf, Baltic Sea, Sweden.

Seven stations were chosen to represent the entire area contaminated by the Tsesis oil spill. Samples were analyzed for species composition, abundance and biomass. This study has indicated a rapid recovery of the phytal system. The oil spill occurred at the beginning of a season of low activity in the phytal zone. The low temperature and ice cover from January to March minimize plant and animal metabolism and growth. Many individuals usually die during winter due to senescence. During these 3-4 months of low activity, before the spring growth started, parts of the remaining oil in the littoral were probably washed out and the toxic fractions diluted. Thus the oil spill did not affect the fauna and flora of this system as much as if the spill had occurred in the beginning of the growth season, in April to June. (See also W80-06738) (Sinha-OEIS)
W80-06744

IMPACT OF OIL ON THE LITTORAL ECOSYSTEM: IN SITU RESPIRATION OF THREE LITTORAL COMMUNITIES NEAR THE TSESIS OIL SPILL,
Stockholm Univ. (Sweden). Asko Lab.
B. Guterstom.
In: The TSESIS Oil Spill. Report of the First Year Scientific Study (October 26, 1977 to December 1978), p 161-165, March 1980. 1 Fig, 1 Tab, 3 Ref.

Descriptors: *Oil spills, *Oil pollution, *Water pollution effects, *Respiration, Littoral, Sediments, Aquatic life, Ecosystems, Environmental effects, *Outer Continental Shelf, *Tsesis Oil Spill, Baltic Sea, Sweden, Fucus vesiculosus, Mytilus edulis, Macoma balthica, Hydrobia sp.

In order to determine if the oil had affected the community metabolism, in situ measurements in plastic bags were made on three typical littoral communities of the northern Baltic: the Fucus vesiculosus community, the Mytilus edulis community, and the 'shallow soft bottoms' with Macoma balthica and Hydrobia spp. as the dominating macrofauna components. The results show a typical picture with relatively low respiration at this time of the year (November). Only the Fucus communities at two oil polluted localities showed higher respiration than similar unpolluted localities. An increased respiration due to exposure to oil at increasing concentrations was found in outdoor experiments with F. vesiculosus. The shallow soft bottoms showed the same respiration at both localities. The same was found with Mytilus from oil polluted localities compared with mussels from unpolluted areas. As oil is still present and is leaching out of the bottoms investigated here, the respiration of these littoral communities is probably influenced to some extent. (See also W80-06738) (Sinha-OEIS)
W80-06745

IMPACT OF OIL ON THE SUPRALITTORAL ZONE: DAMAGE TO SHORE VEGETATION,
Stockholm Univ. (Sweden). Asko Lab.
A. Lindhe.
In: The TSESIS Oil Spill. Report of the First Year Scientific Study (October 26, 1977 to December 1978), p 169-172, March 1980.

Descriptors: *Oil spills, *Oil pollution, *Water pollution effects, Shores, Vegetation, Environmental effects, *Outer Continental Shelf, *Tsesis Oil Spill, Baltic Sea, Sweden.

This study was not begun until the middle of June and by then all the affected coast-1 line including all the fine-grain sediment shores suitable for field study had been cleaned up. In general the plants seemed to be astonishingly little affected by growing on or in close contact with heaps of oil on the shores. This impression is characteristic of all the areas and different types of oil studied. At places with a dense layer of oil, however, the plants showed frequent signs of abnormality or injury. The following observations have been made several times and are, with fair reliability, oil-dependent. Filipendual ulmaria and Lysimachia vulgaris were very dwarfish when growing on soil heavily impregnated with oil. Seedlings of these growing through a thick layer of oil also showed strong malformations. Deformities were also observed in Valriana officinalis and Tussilago farfara. Discoloration, reminiscent of water shortage, was noted in Festuca rubra, Agrostis stolonifera, Atriplix latifolia, and Equisetum arvense when the plants were on or close to oil on the shore. Some specimens seemed less sensitive and Cirsium arvense was found on several occasions growing on thick heaps of oil without visible effects. Although no very significant oil-induced vegetation damage could be demonstrated, one cannot however eliminate the possibility that some effects will show only after a considerable time period. (See also W80-06738) (Sinha-OEIS)
W80-06746

IMPACT OF OIL ON THE SUPRALITTORAL ZONE: EFFECTS ON THE SUPRALITTORAL FAUNA,
Stockholm Univ. (Sweden). Asko Lab.
M. Foberg.
In: The TSESIS Oil Spill. Report of the First Year Scientific Study (October 26, 1977 to December 1978), p 173-189, March 1980. 4 Fig, 6 Tab, 5 Ref.

Descriptors: *Oil spills, *Oil pollution, *Water pollution effects, *Animals, Shores, Environmental effects, Seasonal, *Outer Continental Shelf, Baltic Sea, Sweden, Wrack belts, *Tsesis Oil Spill.

The importance of having knowledge on the effects of an oil spill, not only in the water but also on the adjacent areas above the waterline, is quite obvious since few investigations have been carried out for this purpose, especially in the Baltic Sea. In order to obtain comparable samples, the wrack bed was chosen as a sampling area as it was a biotope which occurred at several of the stations. Three supralittoral stations close to stations B, C, and D and one close to the reference station G were investigated during the first two weeks of August 1978, over nine months after the spill. Unfortunately no similar investigation had been made in this area either before or directly after the accident. The investigation indicates that the oil spill from Tsesis has not had any great and long lasting negative effects on the fauna of the wrack belts of the shore. It seemed to recover rather quickly, due both to the short generation time and the vagility of the animals. Another important factor was the time of the accident. It took place in the late autumn when many animals had already left the upper, most affected part of the ground in preparation for hibernation. (See also W80-06738) (Sinha-OEIS)
W80-06747

IMPACT OF OIL ON LOCAL FISH FAUNA,
Stockholm Univ. (Sweden). Asko Lab.
S. Nellbring, S. Hansson, G. Aneer, and L. Westin.
In: The TSESIS Oil Spill. Report of the First Year Scientific Study (October 26, 1977 to December 1978), p 193-201, March 1980. 4 Fig, 1 Tab, 4 Ref.

Descriptors: *Oil spills, *Oil pollution, *Water pollution effects, *Fish, Ecosystems, Environmental effects, Food chains, *Outer Continental Shelf, Baltic Sea, *Tsesis Oil Spill, Sweden, Clupea harengus membras, Sprattus sprattus.

From earlier echo sounding surveys it is known that pelagic fish (herring, Clupea harengus membras, L. and sprat, Sprattus sprattus L.) are very abundant in the spill area during late autumn and winter. It is also known that herring spawn in the archipelago in the spring. The analysis of herring did not indicate any contamination by oil. The low frequency of spawning by herring in the affected area may indicate effects of oil pollution. It may, however, also be due to the differences that undoubtedly exist between the polluted and reference areas as regards exposure and sediment type distribution on the fairly shallow bottoms, where herring spawn was found. On comparison, it is clear that the hatching of herring eggs was less successful in samples from the oil affected area. Significant differences also between samples from within the polluted area may, however, indicate that factors other than oil pollution may have influenced hatching rate. One such factor was the fungal infection of the roe. In the spring after the oil spill, hardly any adult Gammarids were present in the polluted area. It is therefore possible that their absence led to increased fungal attack on fish roe. (See also W80-06738) (Sinha-OEIS)
W80-06748

LABORATORY STUDIES CARRIED OUT IN CONNECTION WITH THE SPILL: RESPIRATION MEASUREMENTS ON THE MUSSEL MYTILUS EDULIS,
Stockholm Univ. (Sweden). Asko Lab.
S. Hansson.
In: The TSESIS Oil Spill. Report of the First Year Scientific Study (October 26, 1977 to December 1978), p 205-209, March 1980. 1 Fig, 2 Tab, 3 Ref.

Descriptors: *Oil spills, *Oil pollution, *Water pollution effects, *Respiration, Aquatic animals, Mussels, Clams, Environmental effects, Testing, Sampling, *Outer Continental Shelf, *Tsesis Oil Spill, Baltic Sea, Sweden, Mytilus edulis.

In connection with the Tsesis oil spill some laboratory studies were carried out on animals brought to the Asko laboratory from the affected area. The reason for these investigations was to provide information on possible sublethal effects of the oil on organisms in the area. Mussels (Mytilus edulis) were collected by SCUBA diving from the upper 3 m at oil polluted littoral stations from the same depth range at an unpolluted reference station by means of a dredge from the shore. Data from the respiration measurements are presented in tables. According to this study, oil contamination of the water did not significantly change the respiration of Mytilus edulis. However, due to the large variability in respiration, changes would have had to be large, in order to be detected. To detect, with a probability of 90%, a difference in respiration rate of about 20%, the sample size ought to be some 30 specimens. (See also W80-06738) (Sinha-OEIS)
W80-06749

LABORATORY STUDIES CARRIED OUT IN CONNECTION WITH THE SPILL: MEASUREMENTS OF BYSSUS FORMATION BY THE MUSSEL MYTILUS EDULIS,
Stockholm Univ. (Sweden). Asko Lab.
O. Linden, and M. Foberg.
In: The TSESIS Oil Spill. Report of the First Year Scientific Study (October 26, 1977 to December 1978), p 210-212, March 1980. 1 Fig, 4 Ref.

Descriptors: *Oil spills, *Oil pollution, *Water pollution effects, Mussels, Ecology, Environmental effects, Substrate, Testing, Aquatic animals, *Outer Continental Shelf, *Tsesis Oil Spill, Baltic Sea, Sweden, Byssus formation, Mytilus edulis.

Oil-affected mussels were collected in the littoral zone about one week after the grounding of the Tsesis. At this time large quantities of oil were floating on the surface. During the course of the experiment individuals from the impacted area showed decreased tendency to attach to the substrate. This tendency is more pronounced among adult individuals compared to juveniles. It is obvious that affected byssal activity under natural conditions must be considered a serious stress syndrome. Mussels incapable of byssal thread production will be unable to remain in their natural habitat as threads are used as mooring lines. They will consequently be washed away and their chances of reattachment at a suitable place are probably rather small. The experiments, although performed under laboratory conditions, indicate that the mussels in the impacted area were subjected to such effects. (See also W80-06738) (Sinha-OEIS)
W80-06750

LABORATORY STUDIES CARRIED OUT IN CONNECTION WITH THE SPILL: BURROWING BEHAVIOR IN THE CLAM MACOMA BALTHICA,
Stockholm Univ. (Sweden). Asko Lab.
O. Linden.
In: The TSESIS Oil Spill. Report of the First Year Scientific Study (October 26, 1977 to December 1978), p 213-215, March 1980. 1 Fig, 3 Ref.

Descriptors: *Oil spills, *Oil pollution, *Water pollution effects, Behavior, *Clams, Environmental effects, Testing, *Outer Continental Shelf, *Tsesis Oil Spill, Baltic Sea, Sweden, Sublethal effects, Burrowing, Macoma balthica.

Oil-affected clams were collected at 15-20 m depth off Toro about one week after the grounding of the ship. The control animals showed the highest burrowing rate while animals from the polluted area showed a clearly decreased burrowing rate. Clams unable to burrow normally may have their food finding affected as they are deposit feeders. Furthermore, the importance of burrowing behavior in the predator-prey relationship is obvious. The results reported have demonstrated that the clam Macoma balthica during the Tsesis oil spill may have been subjected to such sublethal effects. (See also W80-06738) (Sinha-OEIS)
W80-06751

THE ANALYTICAL CHEMISTRY OF MYTILUS EDULIS, MACOMA BALTHICA, SEDIMENT TRAP AND SURFACE SEDIMENT SAMPLES,
Energy Resources Co., Inc., Cambridge, MA.
P. D. Boehm, J. Barak, D. Fiest, and A. Elskus.
In: The TSESIS Oil Spill. Report of the First Year Scientific Study (October 26, 1977 to December 1978), p 219-274, March 1980. 13 Fig, 10 Tab, 37 Ref. OCSEAP MO-A01-78-4178.

Descriptors: *Oil spills, *Oil pollution, *Aquatic animals, *Water pollution effects, Chemical analysis, Sediments, Environmental effects, *Outer Continental Shelf, *Tsesis Oil Spill, Baltic Sea, Sweden, Analytical chemistry, Sediment traps, Mytilus edulis, Macoma balthica, Aromatic hydrocarbons, Aliphatic hydrocarbons.

This chapter concentrates on the extent of Tsesis oil exposure of the Mytilus edulis population and the long-term (1 year) tissue hydrocarbon burden of populations around the region affected by the spill. Of particular interest were changes in both the quantitative and qualitative nature of the aliphatic and aromatic hydrocarbon assemblages in the tissues. Wacoma balthica, a prominent resident of the soft-bottom community, was used as an indicator of pollutant input to the benthos. The apparent contrasting behavior of Mytilus and Macoma vis-a-vis ingested oil may reflect more the duration of exposure and source transport route of the petroleum than any intrinsic differences in the two bivalve species. Depuration of acutely acquired hydrocarbons by Mytilus is apparently accomplished through flushing of water through the animal's gills. Other studies have shown that depuration of acutely acquired petroleum is fairly rapid though perhaps not complete. The transport and reintroduction to and long resistance time of petroleum in the benthic environment in the regions of the Tsesis spill may result in the much slower recovery of Macoma and the entire soft-bottom community from the effects of this spill, and in general points to the environmental complications caused by transport of petroleum to the benthos. (See also W80-06738) (Sinha-OEIS)
W80-06752

THE PHYTOPLANKTON PRODUCTIVITY OF AN ACIDIC LAKE,
West Virginia Univ., Morgantown. Dept. of Biology.
J. DeCosta, and C. Preston.
Hydrobiologia, Vol 70, p 39-49, 1980. 8 Fig, 7 Tab, 28 Ref. OWRT-A-024-WVA (3), 14-34-0001-6051.

Descriptors: *Acid mine water, Acidic water, Algae, Bioassay, Cations, *Lakes, Nutrients, *Phosphorus, *Phytoplankton, Primary productivity, Reservoirs, Chemical properties, Ecosystems, Limnology, Water pollution, *Water pollution effects, Water quality.

The phytoplankton productivity over two years in a lake heavily loaded by acid mine drainage was very low. Algal assays indicated that below pH 5.5 the water, if buffered and fertilized with phosphorus, resulted in log growth. Above pH 5.5 algal log growth could be induced with phosphorus addition only. However, an in situ bag experiment was done in the lake and immediate bloom conditions of the indigenous algae resulted from phosphorus addition only, despite pH values below 5.
W80-06937

5D. Waste Treatment Processes

WASTE TREATMENT PROCESS,
Ecolotrol, Inc., Bethpage, NY. (Assignee).
J. S. Jeris.
U.S. Patent No 4,182,675, 8 p, 2 Fig, 4 Ref; Official Gazette of the United States Patent Office, Vol 990, No 2, p 616-617, January 8, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Biological treatment, Microorganisms, Biochemical oxygen demand, Equipment, Fluidized bed.

A biological process removes biochemical oxygen demand from waste water by forming a fluidized bed of microorganisms attached to a solid particulate carrier. Waste water to be treated is passed through the fluidized bed. The waste water is retained in the fluidized bed for a sufficient period of time while other necessary parameters are controlled to biologically convert substantially all of the biochemical oxygen demand to methane gas, carbon dioxide and cellular material which are then withdrawn. In one form of the invention nitrified effluent is added to the waste water and the mixture is biologically converted to methane gas, carbon dioxide, nitrogen gas and cellular material. (Sinha - OEIS)
W80-06466

METHOD AND SYSTEM FOR PURIFYING LIQUID,
Almag Chemical Corp., Baltimore, MD. (Assignee).
A. J. Casolo.
U.S. Patent No 4,182,676, 8 p, 2 Fig, 2 Tab, 6 Ref; Official Gazette of the United States Patent Office, Vol 990, No 2, p 617, January 8, 1980.

Descriptors: *Patents, *Waste water treatment, *Industrial wastes, *Water pollution treatment, *Metals, Filtration, Ion exchange, Resins, Hydrogen ion concentration, Water reuse.

A method and system is described for combining filtration and ion-exchange structures to remove mineral contaminants from industrial water. In overall concept, the contaminated water is passed through filtering mediums to remove particulate matter. Organics are removed by passage through adsorbent non-ionic type resins. The water is then

passed through strong acid cation exchange resins, weak base anion exchange resins, weak acid cation exchange resins, and strong base anion exchange resins arranged in a predetermined location in the liquid flow path to provide optimized contaminant removal. One of the optimization techniques is through the pH adjustment of the water at predetermined points in the flow path. Additionally, the water is passed through mixed bed polisher resins as well as chelation resins to provide a final substantially contaminant free liquid which is returned to use in a closed loop fashion. (Sinha - OEIS)
W80-06467

PROCESS FOR REMOVING ORGANIC SUBSTANCES AND NITROGEN COMPOUNDS FROM WASTE WATER,
Stamicarbon BV., Geleen (Netherlands). (Assignee).
A. Klapwijk, and G. Lettinga.
U.S. Patent No 4,183,809, 5 p, 4 Fig, 5 Ref; Official Gazette of the United States Patent Office, Vol 990, No 3, p 995-996, January 15, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, Organic wastes, Denitrification, Microorganisms, Nitrates, Oxidation, Nitrification, Recycling, Equipment.

An improved process for the removal of organic substances and nitrogen compounds from waste water by means of microorganisms is disclosed, wherein waste water to be treated is passed continuously through a denitrification zone. Effluent from the denitrification zone is passed into a nitrification zone, and at least a portion of the effluent from the nitrification zone is recycled back to the denitrification zone. A portion of the waste water to be treated is fed directly into the nitrification zone as well as to the denitrification zone. It is preferred to use a rising-flow reactor with suspended sludge as the denitrification zone. Such preference does not relate to the nitrification zone. In this zone use may be made of any current nitrification system. (Sinha - OEIS)
W80-06469

PROCESS AND DEVICE FOR THE BIOLOGICAL PURIFICATION OF WASTE WATER,
Stamicarbon BV., Geleen (Netherlands). (Assignee).
V. E. A. Baenens, and J. A. L. Thissen.
U.S. Patent No 4,183,810, 8 p, 4 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 990, No 3, p 996, January 15, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, Biological treatment, Nitrates, Nitrites, Control systems, Biochemical oxygen demand, Equipment.

A process and apparatus for the biological purification of waste water containing nitrogen compounds is disclosed. This purification is effected in one or more steps, in the last of which the waste water is denitrified, while additional BOD is added to this step. The supply of BOD to this step is controlled automatically through the continuous analysis of the nitrite-plus-nitrate content in either this step or the discharge from this step. (Sinha - OEIS)
W80-06470

ORGANIC WATER QUALITY CHANGES DURING SAND BANK AND DUNE FILTRATION OF SURFACE WATERS IN THE NETHERLANDS,
Rijksinstituut voor Drinkwatervoor-ziening, Leidschendam (Netherlands).
For primary bibliographic entry see Field 4B.
W80-06494

WATER REUSE FOR GROUNDWATER RECHARGE: AN OVERVIEW,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W80-06495

DENITRIFICATION IN WETLANDS AS A MEANS OF WATER QUALITY IMPROVEMENT,
Florida Univ., Gainesville. Dept. of Soil Science.
D. A. Graetz, P. A. Krottje, N. L. Erickson, J. G. A. Fiskell, and D. F. Rothwell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-222227, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Center, University of Florida, Publication No 48, May 1980. 83 p, 18 Fig, 9 Tab, 98 Ref. OWRT-B-035-FLA (1), 14-34-0001-8073.

Descriptors: *Wetlands, *Waste water treatment, *Denitrification, *Feasibility, Marshes, Swamps, Shallow water, Vegetation, Kinetics, Soils, Time, Rates, Lime, Florida, Ammonia compounds, Fertilizers, Research and development, On-site investigations, Laboratory tests, Soil analysis, Water analysis, Temperature, Oxidation, Reduction(Chemical), Runoff, Sewage treatment, Ecosystems, Farm wastes, Physical properties, Nitrogen compounds, Investigations.

The feasibility of using natural wetlands to remove nitrogen via denitrification from secondarily treated municipal sewage effluent was studied. Nitrification and denitrification occurring in the marsh ecosystem may be an important pollution control treatment for non-point sources such as agricultural runoff. Nitrification and denitrification rates were investigated in the laboratory and in situ. Simulated marsh ecosystems of soil: water columns with artificial aeration were studied. Plants were found to increase the ammonium removal rates. Denitrification did not occur in marsh water or in oxidation pond water without soil. Rapid, first-order denitrification was observed in the soil: water columns and average nitrate removal rates, assuming a floodwater nitrate concentration of 10 milligram N per liter, were about 1.2 kilogram N per hectare per day without plants and 2.0 kilogram N per hectare per day with plants. Denitrification was accelerated by increasing the soil pH with lime. The denitrification and N20 evolution rates for 15 Florida wetland soils were investigated in the laboratory and first-order rate constants ranging from 0.040 per day to 0.192 per day were found for denitrification. For 90% removal about 12 to 58 days of wetland treatment would be required. More research is needed to determine the effects of water depth, oxygen concentration, plant density, and temperature on denitrification rates. (Sidney-IPA)
W80-06507

ENUMERATION AND INACTIVATION OF ENTERIC VIRUSES IN SLUDGE,
Old Dominion Univ., Norfolk, VA. Dept. of Biological Sciences.
M. W. Nath, and J. C. Johnson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-223035, Price codes: A04 in paper copy, A01 in microfiche. Virginia Water Resources Research Center, Virginia Polytechnic Institute and State University, Blacksburg, Bulletin 131, July 1980. 46 p, 3 Fig, 13 Tab, 52 Ref. OWRT A-086-VA (1).

Descriptors: *Sludge, *Viruses, *Enteric Virus, *Waste water(Pollution), Evaporation, Enumeration, Plaquing, Bound-Virus Sludge Solids, Surfactants, Monitoring, Waste water treatment, *Virus isolation methods, Inactivation, Desorption, Extraction and Concentration, Poliovirus-2, Coxsackievirus B-2, Anatid Herpesvirus, Ultracentrifugation, (14C)-Poliovirus.

The presence of large numbers of enteric viruses in wastewaters has resulted in concern regarding their significance and consequence for humans. This study describes virus isolation methods and a new and efficient multiple extraction-concentration procedure for the enumeration of viruses in wastewater sludges. As an integral part of a comparison of isolation procedures, several anionic surfactants were examined for extraction of enteric viruses from primary wastewater sludges. Plaquing efficiencies for poliovirus-2 and coxsackievirus B-2 on several common cell lines were determined. The results demonstrate: (1) that the total poliovirus burden in primary sludge may be determined by means of an efficient extraction procedure followed by concentration by centrifugation, and (2) that dewatering by evaporation is virucidal. The methods described should be useful in monitoring studies of wastewater treatment plant functions, sanitary landfill operations, or any other areas where health assessments are required for the disposal of wastewater sludges.
W80-06535

DYNAMIC RESPONSE OF FINAL SETTLING TANKS TO TRANSIENT LOADING CONDITIONS,
Delaware Univ., Newark. Water Resources Center.
R. I. Dick, and D. R. Pizarro.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-222821, Price codes: A03 in paper copy, A01 in microfiche. Technical Research Completion Report, August 1980, 39 p, 12 Fig, 4 Tab, 16 Ref. OWRT-A-025-DEL (5), 14-31-0001-4008.

Descriptors: *Activated sludge, *Settling velocity, *Waste treatment, *Model studies, Thickening, *Separation techniques, Sludge, Solids separation, Environmental engineering, Waste treatment processes, Biological treatment.

A rational model of the nonsteady state performance of continuous thickeners was developed based on the fundamental concepts controlling the rate of propagation of concentration discontinuities in a suspension. The model predictions were in qualitative agreement with observed experimental results. Quantitative agreement was restricted by ability to predict performance under steady state conditions using a batch flux curve. Improved capability for generating accurate batch flux curves (that is, for accurately measuring settling velocity) are necessary in order to improve dynamic modeling capabilities. With an accurate batch flux curve, this model developed in this research will accurately describe conditions in a gravity thickner under transient loading conditions.
W80-06557

PROCESS FOR SEPARATING HYDROCARBON POLLUTION FROM A HYDROORGANIC MEDIUM,
G. Sader.
U.S. Patent No. 4,184,949, 3 p, 9 Ref; Official Gazette of the United States Patent Office, Vol 990, No 4, p 1374, January 22, 1980.

Descriptors: *Patents, *Wastewater treatment, *Water pollution treatment, Industrial wastes, Oil wastes, Separation techniques, Coagulation, Hydrocarbon pollution, Decantation.

Water, polluted with hydrocarbons and similar pollutants in which separation occurs into an upper layer, rich in hydrocarbons and residues, and a lower layer consisting of a hydrocarbon suspension or emulsion in water, is treated to remove the pollutants from the water. The upper layer is treated with quaternary ammonium salts to separate the heavy residue from a clear (or light-colored) supernatant layer, analogous to fuel oil and reusable; the lower layer is then treated with a mixture of a polyose (starch, for example) and a coagulant (for example, ordinary alum) to obtain a practically pure water. This treatment may be applied to water containing oil products and, in particular, water collected from degreasing and dewaxing plants. (Sinha-OEIS).
W80-06566

SEDIMENTATION DEVICE AND METHOD FOR PURIFYING WASTE WATER,
A. C. Peterson.
U.S. Patent No. 4,184,954, 8 p 5 Fig, 14 Ref; Official Gazette of the United States Patent Office, Vol 990, No 4, p 1375, January 22, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, Separation techniques, Water purification, Sedimentation basins, Gravity separation, Backwashing.

A sedimentation basin for purifying waste water includes first and second basins separated by a baffle and a tube settler mounted horizontally in the baffle. The tube settler comprises individual tubes which connect the two basins. A mechanism is provided to flow unclarified liquid into the first basin and slowly through the tube settler, where particles suspended in the unclarified liquid settle onto an inner surface of the tubes, and resultant clarified liquid flows into the second basin. A tube cleaner is mounted on the device for intermittent registry with an upstream end of the tubes, and creates a suction backwash which reverses the direction of fluid flow with sufficient velocity to dislodge and draw the settled particles from the inner surface of the tubes and flush them into a sludge disposal duct. (Sinha-OEIS).
W80-06567

APPARATUS FOR CLARIFYING WASTE WATER,
Lenox Inst. for Research, Inc., MA. (Assignee).
M. Krofta.
U.S. Patent No. 4,184,967, 7 p, 9 Fig, 4 Ref; Official Gazette of the United States Patent Office, Vol 990, No 4, p 1380-1381, January 22, 1980.

Descriptors: *Patents, *Waste water treatment, *Water purification, Separation techniques, Skimming, Floating, Equipment, Multi-bladed scoop.

An apparatus is disclosed for clarifying treated waste water in which the waste water is floated and settled in a flotation tank equipped with a rotatable carriage provided with multi-scoop means. The multi-scoop is rotated as it is passed through the upper strata of the treated waste water for the removal of floated particles or sludge with no appreciable disturbance of the main body of waste water. The multi-scoop carries the floated particles of sludge to an outlet in an efficient manner without clogging by a unique construction self-cleaning in operation. (Sinha-OEIS).
W80-06568

SUSPENSION OF POWDERED CARBONACEOUS ADSORBENT IN A HYDROCARBON SOLVENT AND ITS USE IN WASTE WATER TREATMENT,
Exxon Research and Engineering Co., Florham Park, NJ. (Assignee).
D. W. Savage.
U.S. Patent No. 4,186,085, 17 p, 8 Fig, 4 Tab, 18 Ref; Official Gazette of the United States Patent Office, Vol 990, No 5, p 1752, January 29, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Organic wastes, *Separation techniques, Adsorption, Carbon, Solvents, Hydrocarbon solvents, Regeneration.

This invention relates to a process for removing organic pollutants comprising predominantly nonbiodegradable organic compounds from waste waters by contacting the waste waters, under adsorption conditions, with a slurry of powdered carbonaceous adsorbent suspended in a hydrocarbon solvent. The use of a powdered carbonaceous adsorbent slurried in a hydrocarbon solvent give high capacity for contaminant removal and enables high rates of contaminant adsorption that are characteristic of powdered activated carbon as well as high carbon utilization due to the slurry being contacted with the waste water continuously and countercurrently. The spent slurry of carbonaceous adsorbent may be regenerated by heating at relatively low temperatures followed by vapor stripping or by solvent extraction. (Sinha-OEIS)
W80-06571

METHOD AND APPARATUS FOR SEPARATING SUBSTANCES FROM LIQUIDS BY FLOTATION USING BUBBLES,
Agency of Industrial Science and Technology, Tokyo (Japan). (Assignee).
Y. Kato.
U.S. Patent No. 4,186,087, 7 p, 3 Fig, 1 Tab, 14 Ref; Official Gazette of the United States Patent Office, Vol 990, No 5, p 1752-1753, January 29, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, Industrial wastes, Heavy metals, Separation techniques, Bubbles, Flotation, Equipment.

The invention provides an apparatus for separating substances from liquids by flotation which comprises a large column with a tube placed inside the column and a means for collecting bubbles at the lower end. The collected bubbles are concentrated at the upper end for enhancing the separation efficiency. The method provides for separating substances from liquids by flotation using bubbles which comprises adsorbing the substances present and floating the bubbles. The bubbles are allowed to ascend through a fluid route in a tube placed inside the column, being independent of the ambient turbulently flowing liquid, and then the bubbles and substance are collected and separated from the liquid at the upper end of the tube. (Sinha-OEIS)
W80-06572

AQUEOUS FERROUS WASTE CONVERSION PROCESS,
SCM Corp., Cleveland, OH. (Assignee).
S. J. Fitch, P. R. Peeling, and D. J. Heiser.
U.S. Patent No. 4,186,088, 8 p, 1 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 990, No 5, p 1753, January 29, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Industrial wastes, *Separation techniques, Metals, Chemical reactions, Sludge, Equipment, Ferrous sulfate, Product recovery, Titanium dioxide.

An aqueous ferrous sulfate waste stream is converted into sludge and improved water effluent by an ambient indoor temperature and pressure flow process. The process comprises: turbulently mixing the stream with a substantial excess of gaseous oxygen and a small excess of impalpable calcium carbonate in a reaction zone until the iron content of the stream is virtually all sludged. The resulting sludge is continuously classified into a coarser solids fraction, a portion of which is recycled to the sludging operation, and an aqueous suspension of finer solids. The finer solids are separated from the aqueous suspension before disposing of the effluent. As such streams usually contain free sulfuric acid, it is desirable to first precipitate a primary gypsum product by neutralization prior to the sludging operation. (Sinha-OEIS)
W80-06573

FINITE ELEMENT ANALYSIS OF EFFLUENT FLOW FROM SUBSURFACE SEWAGE DISPOSAL FIELDS,
Minnesota Univ., St. Paul.
K. A. Janni, J. C. Nye, D. D. Jones, G. W. Krutz, and J. E. Yahner.
Transactions of the American Society of Agricultural Engineers, Vol 23, No 2, p 336-342, March-April 1980. 7 Fig, 4 Tab, 21 Ref.

Descriptors: *Septic tanks, *Waste disposal, *Subsurface drainage, *Model studies, Finite element analysis, Mathematical models, Soils, Soil properties, Soil water, Soil water movement, Effluents, Hydraulic conductivity, Infiltration, Soil moisture, Organic matter, Sewage, Domestic wastes, Path of pollutants.

On-site disposal of home sewage is becoming an increasingly important concern. In 1970, 660,000 of the total 1,721,000 permanent and secondary residences in Indiana were being served by on-site sewage systems. Most of these home sewage systems rely on subsurface infiltration fields for the ultimate disposal of domestic waste. However, some soils have severe limitations and are unsuitable for use as subsurface infiltration fields. Studies have been conducted to test new design specifications to improve operation and to expand the use of subsurface infiltration fields in soils previously designated unsuitable for subsurface disposal. To evaluate these new designs, long term extensive laboratory experiments or field studies of operating systems are required, and the conditions tested are limited by time, money and facilities. Computerized methods of analysis can provide a rapid way to evaluate proposed design modifications of infiltration fields and to coordinate the data collected during disposal field operation. The purpose of this study was to compile the computer programs, utilizing the finite element technique to analyze the two-dimensional effluent flow from a subsurface sewage disposal trench through the infiltration field. (Sims-ISWS)
W80-06623

COMPUTER-AIDED SYNTHESIS OF WASTEWATER TREATMENT AND SLUDGE DISPOSAL SYSTEMS,
Municipal Environmental Research Lab., Cincinnati, OH. Wastewater Research Div.
L. A. Rossman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-174220, Price codes: A08 in paper copy, A01 in microfiche. EPA/600/2-79-158, December 1979. 152 p, 7 Fig, 15 Tab, 27 Ref.

Descriptors: *Mathematical models, *Computer programs, *Waste water treatment, *Sludge disposal, Economics, Costs, Energy, Treatment facilities, Models, Programs, Waste treatment, Water quality, Wastes, Cost analysis, Alternative planning, Land use, Energy consumption.

A computer-aided design procedure (EXEC/OP computer program) was developed for preliminary synthesis of waste water treatment and sludge disposal systems. A penalty augmented implicit enumeration method used in its optimization algorithm proves an efficient means of searching for the best combinations of process options, thereby reducing the need for complete enumeration of all possible alternatives. The program can identify a group of systems designs that have a similar primary objective (e.g., cost), but varying levels of secondary objectives. Case study design problems are given (e.g., preliminary cost/energy-effectiveness analysis for a hypothetical system design having over 15,000 alternative system configurations). Up to 21,000 configurations can be computer process analyzed in several minutes. The program gives the system designer a means to explore trade-offs between criteria such as cost, energy consumption, land utliization, and subjective undesireability ratings. Four Appendices (A-D) provide (A) mathematical development of the system synthesis model (2 Fig, 1 Ref); (B) the EXEC/OP users' guide (4 Tab); (C) a listing of unit process descriptions (19 Ref); and (D) the program listing. (Zielinski-IPA)
W80-06646

ALUM: AN EFFECTIVE COAGULANT: WASTEWATER TREATMENT FOR PHOSPHORUS REMOVAL,
R. W. Ockershausen.
Water and Sewage Works, Vol 127, No 8, p 40-41, August, 1980. 4 Fig.

Descriptors: *Phosphorus, *Alum, *Coagulation, *Waste water treatment, *Treatment facilities, Water quality, Water purification, Facilities, Biochemical oxygen demand, Filtration, Waste treatment, Water quality standards, Activated sludge, Coagulants.

Chemical precipitation using alum for phosphorus removal in waste water treatment plants has a proven 10-yr record. A number of in-plant applications studies have shown added benefits of reducing biochemical oxygen demand (BOD) and suspended solids. The use of alum for phosphorus reduction is indicated by its success at an activated-sludge plant in Avon Lake, Ohio, an activated-sludge followed by rapid-sand-filtration plant in Warren, Michigan, a trickling-filter plant in Richardson, Texas, and a primary treatment plant in Windsor, Ontario. Alum is delivered as a nearly colorless liquid in 4000 gal tank trucks, and contains 43.6% aluminum sulfate (14 waters of hydration), 8.3% aluminum oxide, and 0.05% insolubles, with a dry alum equivalent of 5.4 lb/gal. The Avon Lake plant was among the first in the Great Lakes Drainage Basin to practice phosphorus removal on a continuous basis. Extensive laboratory tests indicated that liquid alum compared with

other coagulants, gave the most effective cost/performance results. The Warren, Michigan, plant incorporated rapid-sand-filtration as part of its 36 MGD activated-sludge plant in 1975, allowing phosphorus removal to meet State standards. Data obtained for these plants are presented. (Zielinski-IPA)
W80-06708

SEWER TRUNK LINES CAN BE TREATMENT FACILITIES,
California Univ., Davis. Dept. of Civil Engineering.
M. Green, and G. Shelef.
Water and Sewage Works, Vol 127, No 8, p 26, 52-53, August, 1980. 2 Fig, 5 Tab, 5 Ref.

Descriptors: *Waste treatment, *Sludge treatment, *Sewers, *Model studies, *Aeration, Chemical oxygen demand, Biochemical oxygen demand, Waste water disposal, Waste water treatment, Wastes, Sewage disposal, Sewage treatment.

Studies were carried out on a laboratory experimental model to test the possibility for using the urban sewer system for sewage treatment, since waste water has typically long detention times in the system. In order to be used in closed loop operation, a proposed connecting pipeline is laid between the sewer system terminus at the activated sludge treatment plant and the beginning of the sewer system. This connecting pipeline is plug-loaded with the activated sludge and is aerated (air/oxygen) with no sewage feed. Application of this concept is discussed relative to the 37 km long Dan Region sewerage system in greater Tel-Aviv, Israel. Biomass used in laboratory model was taken from a pilot plant at Tahel, Tel-Aviv, feeding the reactor with 1 hr settled sewage. The experimental study showed that secondary effluent quality (removal efficiencies of 80% COD and 93% BOD) can be attained using sewage conduits for waste water treatment by introduction of sludge and air. The method can produce a partially reclaimed waste water and treatment plant load reduction. Using a long sewer system under suitable conditions, the use of this method can preclude the need for a treatment plant, except for settling, but further study is needed. (Zielinski-IPA)
W80-06710

TREATMENT AND DISPOSAL OF TOXIC AND HAZARDOUS WASTE,
D and H Waste Management (Pty) Ltd. (South Africa).
P. Scott.
Municipal Engineer (Johannesburg), Vol 9, No 6, p 67-69, 1978. 4 Fig, 1 Tab.

Descriptors: *Waste treatment, *Waste disposal, *Landfills, *Pollution abatement, Regulation, *Toxins, Safety, Oxidation, Biological treatment, Ultimate disposal, Standards, Water pollution, Public health, Storage, Environmental engineering, Permeability, Hydrologic properties, Porosity, Separation techniques, Incineration, Monitoring, Sites, Sealants, South Africa, Surface sealing, Water table, Recycling.

The minimum waste treatment and disposal standards developed by D and H Waste Management (Pty) Ltd., South Africa, are discussed. There are no such standards set by the South African government. D and H has formulated guidelines for three types of sanitary landfill sites: (1) containment sites isolated from the water table by a low permeability seal such as clay or massive crystalline rock formations; absorptive capacity of the site should exceed the average liquid ingress rate by at least 50%; (2) a site separated from the water table by an unsaturated zone of relatively permeable material, thus separating the waste from the water table; and (3) a saturated site in hydraulic continuity with the water table is not acceptable. Several methods of waste treatment are available: (1) biochemical treatment; (2) aqueous inorganic treatment; (3) burning of non-recyclable waste oil and separation and burning of oil/water mixtures; (4) incineration of toxic organic wastes at 400 degrees C; (5) incineration at 1,300 degrees C of spent pesticides; and (6) catalytic oxidation. Once waste has been disposed of, constant monitoring of the site should be maintained. A general index of the requirements for establishing a regional waste disposal site are presented. (Sidney-IPA)
W80-06717

RESEARCH SUMMARY. INDUSTRIAL WASTEWATER.
Environmental Protection Agency, Washington, DC. Office of Research and Development.
Report EPA-600/8-80-026, June 1980. 31 p, 17 Fig, 2 Tab.

Descriptors: *Industrial wastes, *Waste water treatment, *Waste water, *Chemical wastes, *Research and development, Activated carbon, Adsorption, Activated sludge, Organic compounds, Inorganic compounds, Water reuse, Recycling, Electric powerplants, Textiles, Chemical industry, Waste treatment, Industrial plants, Water pollution, Water pollution sources, Water quality.

The EPA research program on industrial waste water falls under two major categories: (1) treatment; and (2) reuse, recycle, and other process modifications. Treatment to remove toxic materials is tested using carbon adsorption, activated sludge, and stream stripping. Wide waste water variability requires treatment research on an industry-by-industry basis. Activated carbon (AC) and wet air oxidation treatment processes are being studied for the organic chemical industry; and powdered AC combined with biological treatment for petrochemical industry waste waters. A 40 million gallon/day waste water full-scale demonstration project is underway in New Jersey. Ammonia and sulfur recovery from petroleum refining by sour water stripping and other treatment research is discussed for the pesticides, inorganic chemicals, battery manufacturing, metal finishing, iron and steel, steam electric power, textiles, leather processing, and paper industries. EPA supported research in waste water reuse/recycle covers steam electric power plant recycling; closed loop reuse for fiberglass industry; closed cycle textile dyeing; AC regeneration; and water reduction in food processing. Identified research projects number 21 at EPA/IERL-Cincinnati, 12 at EPA/IERL-RTP/NC, and 8 at RSKERL-Ada/Oklahoma. Forecasted 1980-85 research will fall under analysis and control of waste water sources, and waste water recyle/reuse development alternatives. (Zielinski-IPA)
W80-06732

TREATMENT OF SEWAGE EFFLUENT,
R. R. Demisch.
U.S. Patent No 4,184,947, 6 p, 5 Fig, 1 Tab, 3 Ref; Official Gazette of the United States Patent Office, Vol 990, No 4, p 1373-1374, January 22, 1980.

Descriptors: *Patents, *Waste water treatment, Water pollution treatment, Sewage treatment, Phosphates, Soil disposal fields, Soil chemical properties, Biodegradation, Sewage effluents.

Effluent from a sewage treatment system, such as a septic tank, a settling chamber, or a settling pond is distributed in or over a leaching bed and is percolated in the presence of entrained air through a filter bed that includes a layer of soil with chemical additives. By admixing chemical additives in the form of hydrous oxides or calcium, aluminum, iron etc., to the filter media significant phosphate removal from the waste is obtained. Potential phosphate removers include red mud, laterite, bauxite and bog iron ore. (Sinha-OEIS)
W80-06807

SEWAGE TREATMENT WITH NESTED SHORT TUBE CONTACT MEDIA,
M. Kato.
U.S. Patent No 4,184,946, 16 p, 37 Fig, 23 Ref; Official Gazette of the United States Patent Office, Vol 990, No 4, p 1373, January 22, 1980.

Descriptors: *Patents, *Waste water treatment, Water pollution treatment, *Sewage treatment, Microorganisms, Resins, Aerobic conditions, Filtration.

A process is provided for sewage treatment in which buoyant filter media made of synthetic resin material are floated in the sewage. Uniform attachment of aerobic microorganisms on the filters is assured by providing an agitating means, thus eliminating the clogging by microorganisms. (Sinha-OEIS)
W80-06808

WASTEWATER TREATMENT SYSTEM,
Campbell Soup Co., Camden, NJ. (Assignee).
L. C. Gilde, Jr.
U.S. Patent No 4,184,789, 12 p, 11 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 990, No 4, p 1326, January 22, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, Sewage treatment, Industrial wastes, Overland flow, Runoff, Biodegradation, Food processing industry.

The overland flow treatment of wastewater involves the application of the wastewater to a sloping terrace of impervious or relatively impervious soil which is planted in a grass crop compatible with heavy irrigation. The wastewater flows in a thin film over the surface of the terrace and becomes purified upon flowing slowly through the grasses and the soil surface by biodegradation of the organic impurities by the soil microorganisms and/or chemical-mechanical removal of inorganics by the soil complex. Since the soil is impervious or relatively impervious, a large percentage of the wastewater is collected as runoff in substantially purified form with the remainder being absorbed into the soil, consumed by the plant life, or evaporated into the atmosphere. The overland treatment is particularly well adapted for the disposal of food processing wastewater containing large amounts of organic materials or other similar types of wastewaters including most municipal sewage wastewaters. The treatment zone in this patent is formed into a series of concentric annular terraces, each of the terraces sloping toward a concentric annular drain. A rotary distribution system pivoted at the center of the terraces is rotated at a predetermined speed to distribute the wastewater over the terraces. (Sinha-OEIS)
W80-06809

PHOSPHATE REMOVAL FROM WASTEWATER,
Union Carbide Corp., NY. (Assignee).
R. F. Drnevich.
U.S. Patent No 4,183,808, 10 p, 3 Fig, 2 Tab, 10 Ref; Official Gazette of the United States Patent Office, Vol 990, No 3, p 995, January 15, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Phosphates, Separation techniques, Activated sludge, Aeration, Biochemical Oxygen Demand, Anoxic zone.

An activated sludge wastewater treatment process for removing phosphate from BOD-containing wastewater is characterized by an improved method for operating the aeration zone with an anoxic treatment zone. BOD-containing influent wastewater is mixed with activated sludge and oxygen-containing gas in an aeration zone to reduce the BOD content of the wastewater and cause the activated sludge bacteria to take up phosphate. Oxygenated phosphate-enriched mixed liquor is formed which is discharged from the aeration zone and passed to a separate zone for concentration of solids to provide a phosphate-depleted effluent and phosphate enriched sludge. At least part of the latter is passed to an anoxic zone to resolubilize phosphate and from solubilized phosphate-containing sludge. A major fraction of the solubilized phosphate-containing sludge is returned directly to the aeration zone as at least part of the activated sludge and without intervening addition of a phosphate precipitant for phosphate removal from the so-returning stream. This sludge serves to biologically remove phosphate from the BOD containing influent wastewater in the aeration zone. (Sinha - OEIS)
W80-06811

TREATMENT OF WASTE WATER RICH IN NUTRIENTS,
National Tax Administration Agency, Chiyoka (Japan). (Assignee); Toho Zinc Co. Ltd, Tokyo (Japan). (Assignee); and The Hokuren Federation of Agricultural Cooperative Assoc., Sapporo (Japan). (Assignee).
K. Yoshizawa, K. Nojiro, K. Mitsutomi, H. Hashimoto, and A. Noguchi.
U.S. Patent No 4,183,807, 7 p, 2 Tab, 8 Ref; Official Gazette of the United States Patent Office, Vol 990, No 3, p 995, January 15, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Organic wastes, Nutrients, Separation techniques, Yeasts, Biochemical oxygen demand, Nutrients, Food processing industry, *Polysaccharide assimilating yeasts, Starch production plants.

Newly isolated polysaccharide assimilating yeasts are added to a waste water rich in nutrients thereby making such yeasts assimilate nutrients, so that B.O.D. of the waste water is efficiently decreased. Among the polysaccharide assimilating yeasts, ellipsoideus YS-1, FERM-P No. 4498, in particular, can decompose and assimilate sulfurous acid, starch and protein at once, and therefore the B.O.D. of the waste water from starch production plants can be considerably decreased. (Sinha - OEIS)
W80-06813

APPARATUS FOR TREATING WASTE-WATERS AND SLUDGES, COMPRISING AN IRRADIATION SYSTEM USING ACCELERATED CHARGED PARTICLES,
C.G.R. MeV, Inc., Paris (France). (Assignee).
G. Azam, A. Bensussan, C. Levaillant, H. Huber, and E. Mevel.
U.S. Patent No 4,184,956, 9 p, 7 Fig, 14 Ref; Official Gazette of the United States Patent Office, Vol 990, No 4, p 1376, January 22, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Water purification, *Irradiation, Flow control, Equipment, Linear accelerators.

An apparatus for treating a fluid constituted with waste-waters and sludges is provided with a system for irradiating the fluid by a beam of accelerated charged particles. The irradiation system is associated with a treatment circuit for obtaining a constant flow of the fluid to be treated and a means for controlling this flow. An irradiation channel of predetermined shape is arranged in the beam path being provided with at least one window transparent to this irradiation beam. The system has means for measuring and controlling the characteristics of the irradiation beam and a safety system to control the characteristics of the irradiation beam and to control the flow of the fluid. (Sinha - OEIS)
W80-06814

CHANGES IN MORPHOLOGY AND PHOSPHATE-UPTAKE PATTERNS OF ACINETOBACTER CALCOACETICUS STRAINS,
University of the Witwatersrand, Johannesburg (South Africa).
E. N. Lawson, and N. E. Tonhazy.
Water S. A., Vol 6, No 3, p 105-112, July, 1980. 4 Fig, 3 Tab, 19 Ref.

Descriptors: *Phosphates, *Sewage bacteria, *Sewage treatment, *Waste water treatment, *Biodegradation, *Pilot plants, Bacteria, Treatment facilities, Chemical wastes, Anaerobic bacteria, Biocontrol, Microorganisms, Oxygen requirements, Water treatment, Waste water(Pollution), Water pollution treatment, Sewerage, Water pollution sources, Biological treatment, South Africa.

Acinetobacter calcoaeticus bacteria were isolated from the Northern Sewage Works pilot plant at Johannesburg in a zone showing high phosphate removal. Isolated colonies from serial dilution plating were examined microscopically. Those composed of gram-negative coccobacilli were subcultured and purified as potential acinetobacter strains. Several of these, grown under limited oxygen availability, changed from typical coccobacilli to large pleomorphic rods. Even where tendency to filament production was exhibited under normal conditions, marked differences in morphology were noted. Four strains were chosen to study phosphate accumulation ability. Cells obtained after growth under reduced oxygen availability had a greater capacity to perform luxury phosphate uptake. Cell growth under more anaerobic conditions altered this capacity to the extent that the physiological characteristics of the bacteria were no longer significant. It is commented that under oxygen deprivation conditions, demand for ATP for nucleic acid synthesis might not be met, causing cellular phosphate leakage; while, under inhibited nucleic acid synthesis, usual cell division cycle is impaired and abnormal cell morphology results. Release from oxygen stress conditions that induced phosphate starvation would result in excess phosphate uptake above that needed. Anaerobiosis obviously plays an important but complex role in biological uptake of phosphorus in waste water treatment plants. (Zielinski-IPA)
W80-06850

MEMBRANE FILTRATION FAECAL COLIFORM DETERMINATIONS WITH UNMODIFIED AND MODIFIED M-FC MEDIUM,
Department of Water Affairs, Pretoria (South Africa). Hydrological Research Inst.
D. P. Sartory.
Water S. A., Vol 6, No 3, p 113-115, July, 1980. 1 Fig, 5 Ref.

Descriptors: *Sewage bacteria, *Analytical techniques, *Coliforms, *Regression analysis, *Sewage effluents, Sewerage, Sewage systems, Waste water treatment, Bacteria, Bacterial growth, Filtration, Sewage treatment, Bioassay, Testing procedures, Water quality, Microorganisms, Membranes, Measurement, South Africa.

Raw sewage and final effluent samples were taken over a seven month period from Baviaanspoort sewage works northeast of Pretoria. River, weir, and irrigation channel water samples were also taken. All raw sewage samples were analyzed by the standard membrane filter method within one hour of collection, while all other samples were analyzed within 1-6 hours. Freshly prepared M-FC medium was divided into two lots, with/without addition of rosolic acid. The filter procedure used Millipore HC membrane filters, incubated 24 hours at 44.5 C, after which all typical blue colonies were counted, and colonies were randomly checked for confirmation testing by gas production from lactose fermentation and indole production from tryptone water. Cultures producing gas and indole were recorded as faecal coliforms. Two-variable linear regression analysis was performed on the data. Membrane filtration counts of faecal coliform bacteria did not differ significantly on M-FC medium with and without rosolic acid. Furthermore, the elimination of rosolic acid did not result in an increase in false positive isolates or interfering background growth. (Zielinski-IPA)
W80-06851

TREATMENT FACILITY WITH BACKWASH CONTROL SYSTEM,
Roberts Filter Mfg. Co., Darby, PA. (Assignee).
C. V. Roberts, W. F. Sarra, and P. J. Neuspiel.
U.S. Patent No 4,187,175, 9 p, 2 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 991, No 1, p 251, February 5, 1980.

Descriptors: *Patents, *Wastewater treatment, *Water pollution treatment, Industrial wastes, Domestic wastes, Filtration, Control systems, Separation techniques, Suspended solids, Filters, *Backwashing, Granular beds.

A treatment facility has a granular media bed for use in acting upon (e.g. filtering) liquid mixtures, such as industrial and municipal water and wastewater, and employs a backwash operation between treatment operations for cleaning or otherwise enhancing the quality of the bed. A control system for the backwash operation establishes a first backwash rate for washing and scouring the granular media to release suspended solids and/or other impurities from the bed. Thereafter the control system establishes a second and generally greater rate for removing the released impurities from the facility. Preferably the first rate is chosen to just completely fluidize the granular bed, at which point a pressure responsive control system detects a constant differential pressure (i.e., a zero change in differential pressure), and the second rate, which generally is greater than the first rate, is responsive to the temperature of the backwash liquid. (Sinha -OEIS)
W80-06944

HEAVY METAL SEPARATION FROM WASTES EMPLOYING IRRADIATION,
C.G.R.-MeV, Paris (France). (Assignee).
C. Levaillant.
U.S. Patent No 4,187,176, 4 p, 1 Fig, 8 Ref; Official Gazette of the United States Patent Office, Vol 991, No 1, p 251-252, February 5, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, Industrial wastes, Separation techniques, Heavy metals, Centrifugation, Irradiation, Equipment.

The invention provides a treatment plant for treating waters and sludges using a beam of ionising radiation and comprising: a system for decanting the primary waters and sludges; a first centrifugal separating system for the waters and sludges left after decantation--the spent waters, the sludges formed by organic compounds, not including heavy metals and the sludges formed by mineral compounds; an irradiation apparatus supplying a beam of ionising radiation for irradiating the sludges formed by organic compounds especially those including heavy metals, which are converted into mineral compounds of greater density; and a second centrifugal separating system intended to reseive the irradiated sludges and to separate them, according to their density, into clarified waters, sludges formed by organic compounds which are freed from heavy metals and sludges formed by mineral compounds containing heavy metal derivatives. (Sinha - OEIS)
W80-06945

PROCESS FOR PURIFICATION OF SANITARY WATERS,
F. Besik.
U. S. Patent No 4,188,289, 10 p, 3 Fig, 1 Tab, 11 Ref; Official Gazette of the United States Patent Office, Vol 991, No 2, p 618-620, February 12, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, Water purification, Separation techniques, Biological treatment, Adsorption, Oxidation, Chemical precipitation, Nitrification.

The invention provides a process for purification of waste waters in which the various biological, chemical and physical processes required to remove pollutants can be carried out in a single sludge system in a single reactor divided by vertical partitions into independent reaction zones. Processes carried out in the first three reaction zones include: adsorption of dissolved organic matter by fluidized suspended solids; biooxidation of biodegradable organic matter; ammonification followed by biological nitrification simultaneously with respiratory denitrificatipn; chemical precipitation of phosphorus; and continuous separation of fluidized bed solids form the purified waste water and recirculation of the fluidized bed solids. The processes carried out in the fourth reaction zone include: chemical oxidation or residual organics and toxic compounds; kill of bacteria and viruses by added oxidizing agents; chemical precipitation of metal ions; and separation of precipitates. The chemical decomposition of the unreacted oxidizing agents by reaction of the agents with charcoal is carried out in the fifth reaction zone. (Sinha - OEIS)
W80-06948

TREATMENT OF INDUSTRIAL WASTE WATER,

D. R. Anderson.
U. S. Patent No 4,188,291, 6 p, 3 Fig, 7 Tab, 17 Ref; Official Gazette of the United States Patent Office, Vol 991, No 2, p 620, February 12, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Industrial wastes, Separation techniques, Reverse osmosis, Chemical precipitation, Calcium carbonate, magnesium hydroxide, Recycling, Blow down water.

A method is disclosed for processing industrial waste waters and, in particular, blow down water from thermal electric plants. The water is processes to concentrate the salts and to obtain a concentrated brine which can then be passed to a thermal evaporator and/or solar evaporation ponds. The water is processed by the additon of magnesium hydroxide and carbon dioxide in amounts sufficient to precipitate the calcium as calcium carbonate, thereby obtaining a water reduced in calcium content and increased in magnesium content. The treated water is processed to recover a purified water from a brine, preferably by reverse osmosis. Calcium hydroxide is added to the brine generated by the reverse osmosis process in an amount sufficient to precipitate magnesium hydroxide which can be recycled to supply the magnesium hydroxide used in the pre-treatment. A clarified brine is recovered from the magnesium hydroxide precipitation step and may then be naturally or thermally evaporated to produce a saturated slurry of salt solids. This slurry can then be further reduced to dryness by solar evaporation. (Sinha - OEIS)
W80-06949

INEXPENSIVE PURIFICATION OF UREA WASTE STREAMS,
Standard Oil Co. (OH), Cleveland. (Assignee).
W. O. Fitzgibbons.
U. S. Patent No 4,188,292, 5 p, 5 Tab, 8 Ref; Official Gazette of the United States Patent Office, Vol 991

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, Industrial wastes, Separation techniques, Urea, Anions, Cations, Resins, Chemical reactions, Recycling.

Urea is destroyed in aqueous waste streams containing various anions and cations plus urea by contacting the stream with a cation exchange resin, then reacting the resulting stream with nitric oxide, nitrous acid or a nitrite salt to convert the urea to nitrogen, carbon dioxide and water and treating the resulting stream with an anion exchange resin. A pure aqueous stream is obtained which does not adversely affect the environment and which may be recycled to a plant as fresh water resulting in large monetary savings in fresh water cost. (Sinha - OEIS)
W80-06950

5E. Ultimate Disposal Of Wastes

LOCAL MUNICIPALITIES HAVE GOT A CHALLENGING TASK (PLAASLIKE OWERHEDE HET 'N UITDAGENDE TAAK),
Department of Planning and the Environmental, Pretoria (South Africa).
T. J. Botha, and G. A. Visser.
Imiesa (Johannesburg), Vol 4, No 4, p 20-21, April 1979. 1 Fig.

Descriptors: *Municipal wastes, *Solid wastes, *Environmental effects, Water pollution, Water pollution abatement, *Waste disposal, *Waste water treatment, Sewage sludge, Water quality, Sludge disposal, Cities, Eutrophication, Landfills, South Africa.

Waste management in South African cities is discussed with respect to environmental aspects, resources recovery and pollution abatement. Water quality criteria, including eutrophication, has a major influence on the management of water resources. Training facilities and criteria for the disposal of municipal solid wastes are also discussed. Suggested ways to dispose of sewage sludge from waste water treatment plants are: use in landfills, agricultural use, composting, ocean dumping and incineration. Public participation can help reduce waste disposal problems and littering. (Stiles-IPA)
W80-06455

THE WET-AIR OXIDATION OF RUM DISTILLERY WASTES,
Puerto Rico Univ., Mayaguez. Dept. of Chemical Engineering.
R. Munoz-Candelario, M. Pedraja-Santos, A. Rodriguez-Ramirez, J. Hernandez, and G. Colon-Burgos.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-224942, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute, University of Puerto Rico, Report, February 1979. 27 p. OWRT-A-048-PR (1).

Descriptors: *Waste water treatment, *Industrial wastes, *Pollution abutment, *Puerto Rico, *Rum distillery wastes, Water pollution control, Methodology, Wet-air oxidation, Thermal cracking.

The aqueous-phase oxidation of rum distillery wastes was done batchwise at temperatures ranging from 350F to 550F and at air pressures from 500 psig to 2000 psig. The maximum percent conversions obtained were 67.2% in biochemical oxygen demand, 54.4% in chemical oxygen demand, 58.8% in total organic carbon, and 60.8% in total carbon. The reaction times required to achieve these reductions varied from 8 to 10 hours, smaller values being obtained at shorter reaction times. The rate of reaction was found to be independent of pressure, and the process followed first order kinetics. Thermal cracking occurred concurrently with the oxidation reaction.
W80-06559

ENVIRONMENTAL FACTORS IN APPLICATION OF LIQUID SLUDGE TO UPSTATE NEW YORK FARMLANDS,
Technical Completion Report State Univ. of New York at Binghamton. Dept. of Chemistry.
B. McDuffie, P. Figura, R. W. Lahann, R. C. Campbell, and R. E. Andrus.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-225352, Price codes: A07 in paper copy, A01 in microfiche. January 1980. 130 p, 19 Fig, 18 Tab, 85 Ref, 4 Append. OWRT B-070-NY (1), 14-34-0001-7126.

Descriptors: *Sludge disposal, *Water pollution, Cadmium, Nickel, Zinc, *Acidic soils, Agriculture, *Corn(Field), Sweet corn, Food chains, *Experimental farms, *Sewage sludge, Hay, Silage, Potatoes, Tomatoes, Surface Waters, Wells, Nutrients, Soil chemical properties, Chromium, Copper, Lead, Cation exchange, Migration, Organic matter, Polychlorinated biphenyls, Soil microbiology, *Trace metals, Bioaccumulation, *Cd-enriched soil, Corn varieties, Corn leaf, Corn grain, Binghamton(NY), Federal regulations.

Sewage sludge application to farmland near Binghamton, New York, began in July 1975 and was monitored from 1976 into 1978. A dry weight of 56 ton/acre of anaerobically-digested liquid sludge was sprayed onto the 80-acre site in 3 years with intermittent plowing, increasing average trace metal concentrations in soil as follows: Cd 8.7, Cr 86, Cu 110, Ni 48, Pb 68, Zn 190 ppm. Soil fertility, organic carbon, and exchange capacity increased, but soil pH decreased from around 6 to 5. Surface waters and wells showed no evidence of chemical pollution from nutrients or trace metals. Crops from the farm and from experimental garden plots (sludged and control) in 1976 and 1977 were analyzed for trace metals. Hay increased in Cd, Cr, Cu, Ni, and Zn. Field corn accumulated Cd, Ni, and Zn (540-845 ppm) in the leaf, also Ni, some Zn, and traces of Cd (0.04-0.08 ppm) in grain. In garden plots, sludging increased Cd in corn leaf and grain, potatoes, and tomatoes, Ni in corn grain and potatoes, and Zn in corn leaf and slightly in grain. Sweet corn accumulated 4-5X more Cd than field corn in grain and 4-8X more in leaf. This significant difference in Cd uptake by corn varieties and the low bioaccumulation in field corn grain from Cd-enriched acid soils has food-chain and possibly regulatory implications.
W80-06564

DRAINAGE REQUIREMENTS FOR LAND APPLICATION WASTEWATER TREATMENT,
Robert S. Kerr Environmental Research Lab., Ada, OK.
W. C. Galegar, C. C. Harlin, Jr., and C. G. Enfield.
Transactions of the American Society of Agricultural Engineers, Vol 23, No 2, p 343-345, 350, March-April 1980. 2 Fig, 1 Tab, 7 Ref.

Descriptors: *Waste water disposal, *Land management, *Application methods, Infiltration, Overland flow, Percolation, Vegetation, Vegetation effects, Sewage, Sewage effluents, Evaporation, Crops, Drainage, Irrigation, Land application.

Drainage requirements for land application wastewater treatment were discussed based on the mode of treatment: slow-rate (irrigation), rapid-infiltration, or overland-flow. The pertinent characteristics of each of the treatment modes were introduced and differences in drainage requirements discussed. (Sims-ISWS)
W80-06670

TREATMENT AND DISPOSAL OF TOXIC AND HAZARDOUS WASTE,
D and H Waste Management (Pty) Ltd. (South Africa).
For primary bibliographic entry see Field 5D.
W80-06717

THE CASE FOR LICENSING WASTE DISPOSAL SITES IN SOUTH AFRICA,
D and H Waste Management (Pty) Ltd. (South Africa).
P. D. Scott.
Imiesa, Johannesburg, Vol 3, No 10, p 19, 23, and 31, 1978. 3 Fig.

Descriptors: *Landfills, *Waste disposal, *Waste treatment, *Environmental pollution, *Permits, Sites, *South Africa, Geology, Hydrogeology, Design criteria, Waste management, Mine wastes, Industrial wastes, Acid mine water, Domestic wastes, Water pollution, Sludge treatment, Solid wastes, Fly ash, Health aspects, Legal aspects.

The need for and ways of implementing licensed sanitary landfills in South Africa are presented. The main sources of wastes are mining, power station, industrial, and trade and domestic. Mining wastes make up the major share of water and environmental pollution in South Africa. Fly ash generated by coal-fired power stations and coal based chemical plants is the second largest pollutant. A brief description of waste management techniques in the United States, the United Kingdom, West Germany, and Japan is offered. The points are made that the United Kingdom appears to lead the world in the field of effective but economical waste disposal, and that its' system would best suit South Africa. Common to these countries is the licensing of waste disposal sites to ensure that they meet established minimum criteria in order to prevent environmental pollution. Today, few of the waste disposal sites in South Africa meet these criteria. Location, preparation and operation of waste disposal sites are discussed with respect to geology, hydrology, and the sealing of the filled site with a relatively impermeable layer of material. Waste pre-treatment is described. It is considered essential to compose a list of acceptable industrial hazardous wastes, and a register kept of wastes actually received. (Stiles-IPA)
W80-06735

FINITE ELEMENT ANALYSIS OF THERMAL CONVECTION IN DEEP OCEAN SEDIMENTS,
Sandia National Labs., Albuquerque, NM. Heat Transfer and Fluid Mechanics Div.
For primary bibliographic entry see Field 2L.
W80-06927

5F. Water Treatment and Quality Alteration

FEASIBILITY STUDY TO DETERMINE THE PRACTICALITY OF USING POTABLE MUNICIPAL WATER SUPPLIES AS A SOURCE OF CONDENSER COOLING WATER FOR POWER GENERATING FACILITIES,
Texas Tech Univ., Lubbock. Water Resources Center.
R. H. Ramsey, R. D. Bowersock, L. V. Urban, J. H. Strickland, and R. M. Sweazy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-225360, Price codes: A06 in paper copy, A01 in microfiche. Final report, August, 1980. 114 p, 17 Fig, 19 Tab, 1 Append. OWRT B-226-TEX(1), 14-34-001-9135.

Descriptors: *Municipal water, *Cooling water, *Water distribution(Applied), *Water conservation, Industrial water, Water consumption, Energy, Energy loss, Economics, Thermal pollution, Temperature, Ponds, Laboratory tests, Project planning, Water treatment, Water purification, Management, Design, Viscosity, Environmental effects, Sedimentation, Storage, Water Conservation, Social aspects, Electric generators.

The feasibility of using potable municipal water supplies prior to treatment, as condenser cooling water for an energy generation facility is discussed. The raw water would be drawn from the supply source, stored, and used for the once-through cooling system. The discharged warm water would be placed in a storage pond where it would be drawn, treated, and distributed to water consumers in the system. Potential benefits may be realized by reducing capital investment, warming the water to enhance the effect of water treatment, and increasing access to an additional water source. Laboratory experiments simulating water treatment operations using alum and bentonite at various temperatures indicated that viscosity plays an important role in sedimentation. A reduction in the amount of energy required for heating water is possible and the increased solids settling performance will reduce the capital and amortization costs for water treatment facilities. Any unfavorable environmental impact caused by elevated water temperatures can be minimized through design and management considerations. The results of a questionnaire mailed to a test population in seven southwestern cities indicated a majority (73.3%) of the respondents favored the concept of an integrated cooling water and water treatment system. (Sidney-IPA).
W80-06563

CHEMICAL, PHYSICAL, AND RADIOLOGICAL QUALITY OF SELECTED PUBLIC WATER SUPPLIES IN FLORIDA, JANUARY-MAY 1979,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5A.
W80-06589

A COMPUTER METHOD FOR LOADING MODEL NETWORKS,
Denver Water Dept. CO.
A. L. Cesario, and T. K. Lee.
Journal of the American Water Works Association, Vol 72, No 4, p 208-213, April 1980. 9 Fig.

Descriptors: *Computer models, *Pipelines, *Networks, *Estimating equations, *Loads(Forces), Pressure, Design, Mathematical models, Optimization, Model studies, Input-output analysis, Dynamic programming, City planning, Project planning, Planning, Water distribution, Distribution systems, Public utilities, Mechanical properties, Analysis, Pipe flow, Pressure conduits, Pumping, Boundries(Property), Time series analysis, Physical properties, Economics.

An efficient, flexible method for the mathematical modeling of large water distribution systems performed by the use of a computer program designed by Denver's Water Department is described. The modeling can be used to perform operational and planning studies to optimize the system and the model is adjusted by changing pump lifts, pressure-regulating valve settings, valve position, and reservoir elevations. Time-varying loads for nodes can be quickly and easily calculated with this method. Nodes are assigned coordinates on a grid system, while pressure zone boundry lines are defined by sets of coordinates with a load network of 50 to 900 nodes. Pipe data is not necessary, but it can be included and the program can accommodate about 400 zone boundry segments, 1750 quarter sections, and 25 details. Scan range and number of zone boundry points seem to have the most effect on processing time and the typical cost of analyzing a large system with 840 nodes with 582 zone boundry points is about $537. For each grid square within the project boundry, the program searches for the closest node and the pressure zone boundries (PZB) are checked for interference. Once the node that is closest to the square PZB interference is located, the load corresponding to the square is assigned to that node. A further sophistication of the program will be the inclusion of nonuniform load distribution and the elimination of the need for pseudo nodes. (Sidney-IPA)
W80-06636

THE EFFECTIVENESS OF IN-LINE AQUEDUCT TREATMENT,
Consulting Engineers, Inc., Pasadena, CA.
G. P. Treweek.
Journal of the American Water Works Association, Vol 72, No 4, p 214-219, April 1980. 9 Fig, 3 Tab, 16 Ref.

Descriptors: *Los Angeles aqueduct, *Water treatment, *Flocculation, *Turbidity, *Flow, Flow resistance, Aqueduct, Chemical precipitation, Colloids, Optimization, Evaluation, Quality control, Soil aggregates, Water quality, Reservoirs, Polymers, Pipelines, Roughness(Hydraulic), Adsorption, Separation techniques, Sedimentation, Suspended load, Water levels, Statistical methods.

The effect of in-aqueduct flocculation and sedimentation on flow and turbidity in the Los Angeles aqueduct was analyzed by statistical methods. The aqueduct system collects water from streams flowing down the eastern slopes of the Sierra Nevada Mountains into the Owens River to the Haiwee reservoir, Fairmont reservoir, and eventually to the Los Angeles reservoir complex. Presently the suspended particulate matter is coagulated by the addition of cationic polymer in the aqueduct near the city of Mojave and settled in the Fairmont reservoir thirty miles downstream. The mean flows with polymer are about 3% lower than without polymer probably due to adsorption of the aggregates of suspended matter on the aqueduct walls. Turbidity measurements indicated that smaller colloidal material less than 1 micrometer in diameter are not adequately removed and the turbidity was only decreased about 40%. Sedimentation in the Fairmont reservoir removes about 90% of the suspended solids and 75% of the detectable particulate volume. The aqueduct flow is also a fuction of the clearance between the water level and the aqueduct cover and several times during the study the flow had to be reduced to avoid having the water level reach the aqueduct lid, causing backwater. The in-line flocculation of suspended colloidal material in raw water is successful, as indicated by the shift in the differential volume system and this can be optimized by further design modifications. (Sidney-IPA)
W80-06637

REMOVAL OF RADIUM-226 FROM SARASOTA COUNTY, FLORIDA, DRINKING WATER BY REVERSE OSMOSIS,
T. J. Sorg, R. W. Forbes, and D. S. Chambers.
Journal of the American Water Works Association, Vol 72, No 4, p 230-237, April 1980. 8 Fig, 6 Tab, 12 Ref.

Descriptors: *Reverse osmosis, *Radium radioisotopes, *Water treatment, *Evaluation, Performance, Radioactivity, On-site investigations, Florida, Sampling, Design, Hardness(Water), Calcium, Suspended solids, Magnesium, Demineralization, Membrane processes, Efficiencies, Control, Economics, Sodium, Chlorides, Trace elements, Water supply, *Radium-226 removal, Sarasota County(FL), Drinking water.

The efficiency of eight reverse osmosis (RO) treatment systems in removing naturally occurring Ra-226 from Sarasota County, FL, water supplies is discussed. Most of the water supplies have Ra-226 concentrations in the range of 0.3 to 22.0 picocuries per liter and the maximum contaminant level is 5 picocuries per liter. Field studies were carried out during a six-month period from January to June 1977 on the eight RO systems which varied in design capacity, in manufacturer, in age, and in the quality of the raw well water treated. All the water samples obtained from the systems were analyzed for radium content and trace element content. The best removals on a percentage basis (85-99%) for the systems as a group were achieved for total dissolved solids, hardness, calcium, magnesium, and sulfate and Ra-226 removals of 87 to 98%. Lower removal (60-85%) of chloride and sodium occurred. A lead time for peak efficiency for Ra-226 removal by the RO systems was estimated at about one or two minutes after start-up. Selenium and fluoride concentrations in the raw water were lowered in most cases. Despite the high cost of an RO system, it is advantageous for water treatment on a small scale such as for a school or trailer park. The disposal of the contaminated reject water and the high cost of the membranes still remain the major problems with RO systems. (Sidney-IPA)
W80-06639

A FLUORIDE OVERFEED INCIDENT AT HARBOR SPRINGS, MICHIGAN,
Michigan Dept. of Public Health, Lansing. Bureau of Environmental and Occupational Health.
D. E. Leland, K. E. Powell, and R. S. Anderson, Jr.
Journal of the American Water Works Association, Vol 72, No 4, p 238-243, April 1980. 6 Fig, 3 Tab, 3 Ref.

Descriptors: *Accidents, *Fluoridation, *Michigan, *Public health, On-site investigations, Water treatment, Tracers, Water quality, Water supply, Water management(Applied), Water distribution(Applied), Reservoirs, Pipelines, Safety, Electrical equipment, Maintenance, Monitoring, Wells, Pumping, Calcium chloride, Valves, Regulation, Electrical switches, Epidemiology, Fluoride overfeed, Drinking water, Toxicity, Harbor Springs(MI).

An investigation was conducted in the resort town of Harbor Springs, Michigan, to determine the cause and the effects of a fluoride overfeed incident in the municipal water system on November 22, 1977. Four people became ill after drinking the contaminated metallic-tasting water which was estimated to contain enough fluoride to induce vomiting (about a 29 milligram dose). Four wells are used in the peak tourist months, but only one well, the Peffer well, is used during the winter. The overfeed occurred as a result of a malfunction of the shut-off valve for the fluoridation equipment after the signal lines to the reservoir and wells were severed. All wells began operation and were shut down immediately after the signal disruption and several hours later, the whole water system was flushed. Investigation after the overfeed event indicated a little less than 86 kg of 25% hydrofluorsilicic acid had been pumped into the water system. Simulation of the event by the addition of calcium chloride dihydrate to the water system and measurement of chloride concentrations at several city sites confirmed the suspicion that excess fluoride had caused the four illnesses. No other illnesses were traced to the fluoride overfeed in a subsequent epidemiological study. It is recommended that all chemical feed equipment be interconnected electrically with the pumping equipment to prevent a reoccurrence of a similar event at the water pumping station. (Sidney-IPA)
W80-06640

MANAGING SMALL WATER SYSTEMS: A COST STUDY. VOLUME I,
Municipal Environmental Research Lab., Cincin-

nati, OH. Drinking Water Research Div.
For primary bibliographic entry see Field 6C.
W80-06644

ESTIMATING WATER TREATMENT COSTS. VOLUME 2. COST CURVES APPLICABLE TO 1 TO 200 MGD TREATMENT PLANTS,
Culp/Wesner/Culp, Santa Ana, CA.
For primary bibliographic entry see Field 6C.
W80-06645

ELECTRONIC INSTRUMENTATION ADDS DIMENSIONS TO METERING,
Rockwell International, Uniontown, PA, Municipal and Utility Div.
E. M. Weinberger.
Water and Sewage Works, Vol 127, No 8, p 46-47, 57, August, 1980. 4 Fig.

Descriptors: *Electronic equipment, *Water control, *Flow measurement, *Control systems, Monitoring, Chlorination, Pumps, Valves, Flow control, Flow system, Automation, Flow rates, Water rates, Water control, Instrumentation, Computers, Water systems, Signals, Electronic instrumentation, Water treatment and distribution systems.

Electronic monitoring instruments can immediately alert water managers/operators to an excessive flow through the system by activating alarm systems at local and remote locations, recording the time and magnitude of the break, and provide a variety of other signals to initiate corrective actions for providing positive control of water treatment and distribution systems on a real-time basis. The topics of instrument basics, local and remote instrumentation, water treatment/control, computer management, general applications, flow control, and demand billing are reviewed. Instruments can provide a variety of signals and control such devices as pumps, valves, chlorinators, chemical feeders, and other control devices. Since signals offer broad system control and data readouts locally and remotely, these instruments are converted from simple slave devices into tools for system automation and control. General applications include use of a quantity controller signal to close an electronic solenoid-operated valve after a preselected quantity of water has been delivered (e.g., in water quantity use limited by contract); use of a second set-point to control a bypass valve when necessary to close a main valve rapidly at high flow rates; and alternating two water softeners. Schematics for various applications are illustrated. (Zielinski-IPA)
W80-06709

MIXED-FORM POLYHALIDE RESINS FOR DISINFECTING WATER,
Aqua-Chem, Inc., Milwaukee, WI. (Assignee).
G. L. Hatch.
U.S. Patent No 4,187,183, 4 p, 4 Tab, 7 Ref; Official Gazette of the United States Patent Office, Vol 991, No 1, p 254, February 5, 1980.

Descriptors: *Patents, *Water treatment, *Water purification, *Water quality control, Disinfection, Bactericides, Iodine, Bromine, Resins.

A mixed-form polyhalide bactericidal and virucidal resin is prepared by adding to a strong base anion-exchange resin a slurry mixture of elemental iodine, interhalogen, or bromine and an appropriate amount of an iodide or bromide salt. Iodine or bromine liberated from such bactericidal resins during water treatment may be readily scavenged by an unloaded anion-exchange resin and the hypohalous acid can be removed by further treatment with activated charcoal. (Sinha - OEIS)
W80-06946

5G. Water Quality Control

WATER SCREEN,
L. D. Sanders, and M. E. Gilbert.
U.S. Patent No 4,182,414, 6 p, 4 Fig, 1 Tab, 6 Ref; Official Gazette of the United States Patent Office, Vol 990, No 2, p 531, January 8, 1980.

Descriptors: *Patents, *Filters, *Screens, Water quality, Filtration, Water treatment, Particulate matter.

A water screen displays a variable filtration feature where the screen comprises a pipe length made of a compressible plastic material. The pipe length is provided with inlet openings thereby permitting fluid located peripheral to the exterior surface of the pipe length to be transported through the inlet openings and at the same time filtering particulate matter and debris from the water. The plastic material of the water screen is chosen from the group comprising polyvinylchloride, polypropylene and polyethylene. (Sinha - OEIS)
W80-06456

PROCESS FOR REMOVING HEAVY METAL IONS FROM AQUEOUS FLUIDS,
Olin Corp., New Haven, CT (Assignee).
J. M. Popplewell.
U.S. Patent No 4,182,399, 7 p, 5 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 990, No 2, p 526, January 8, 1980.

Descriptors: *Patents, *Water treatment, *Water quality control, *Industrial water, Metals, Corrosion, Heat exchangers, Aluminum, Equipment, Heavy metals, Ions, Ion removal, Getter components, Solar energy collector systems.

The invention provides a highly efficient method and apparatus for removing corrosive heavy metal ions thereby increasing the effective life of the aluminum components of a heat exchange system. The heat exchange system is provided with a getter component located upstream of the aluminum heat exchanger to remove corrosive heavy metal ions prior to contact with the aluminum component. The getter component is readily inserted into and removed from the system thereby allowing easy replacement on a periodic basis. The invention provided for getters which are designed to provide a high degree of turbulence in the heat exchange fluid flow thereby achieving maximum getter efficiency. (Sinha - OEIS)
W80-06457

OIL SKIMMER,
P. Van Hekle.
U.S. Patent No 4,182,679, 9 p, 8 Fig, 11 Ref; Official Gazette of the United States Patent Office, Vol 990, No 2, p 618, January 8, 1980.

Descriptors: *Patents, *Oil spills, *Oil pollution, Separation techniques, Water quality control, Skimming, Equipment, Oil skimmer.

Floating mineral substances such as oil or petroleum are separated from water by collecting the mixture in the inlet of a separator tank having a generally L-shaped baffle with surface irregularities formed on the vertical wall of the baffle and with the mixture flowing through the wattom wall into a pyramidal shaped storage section. By means of its shape, it causes the water to flow downwardly into the storage section and the oil to float on top into an oil chamber. Pumps are provided to remove the oil from the oil chamber and to maintain the water at the proper level in the storage section. The device is mounted on the front of a barge vessel. (Sinha - OEIS)
W80-06468

EXPERIMENTAL SALINITY ALLEVIATION AT MALAGA BEND OF THE PECOS RIVER, EDDY COUNTY, NEW MEXICO,
Geological Survey, Oklahoma City, OK. Water Resources Div.
J. S. Havens, and D. W. Wilkins.
Geological Survey Water-Resources Investigations 80-4, December 1979. 65 p, 23 Fig, 10 Tab, 37 Ref.

Descriptors: *Salinity, *Water quality, *New Mexico, *Brines, Inflow, Aquifers, Saline water intrusion, Pumping, Groundwater, Reservoir leakage, Instrumentation, Data collections, Chemical analysis, *Pecos River(NM), *Eddy County(NM), *Malaga Bend(NM).

Upward-leaking brine, from a confined aquifer at the base of the Rustler Formation, mixes with fresher water in a shallow aquifer, resulting in discharge to the Pecos River in southern Eddy County, New Mexico, of about 0.5 cubic feet per second of saturated brine. Pumping brine from the aquifer at a rate greater than 0.5 cubic feet per second lowered the potentiometric head in the confined aquifer. From July 22, 1963, through December 1968, approximately 3,878 acre-feet of brine had been pumped into the Northeast Depression. The depression leaked brine to the Pecos River. Water downgradient of the depression increased in specific conductance ranging from 1,500 to 99,400 milligrams per liter chloride and water levels near the depression increased over 3 feet from 1963 to 1968. For water years 1952-63, the Pecos River gained about 240 tons per day of chloride in the reach from Malaga gaging station to Pierce Canyon Crossing. The average chloride gain to the Pecos River from July 1963 to August 1966 was 167 tons per day; the 1967-68 gain increased to 256 tons per day after a major flood in August 1966. (USGS)
W80-06513

MODEL STUDY OF HARRY S. TRUMAN SPILLWAY, OSAGE RIVER, MISSOURI,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 8B.
W80-06547

WATER SOFTENING METHOD USING THERMALLY REGENERABLE ION EXCHANGE RESIN,
Rohm and Haas Co., Philadelphia, PA. (Assignee).
S. S. Dabby, and E. J. Zaganiaris.
U.S. Patent No. 4,184,948, 7 p, 10 Ref; Official Gazette of the United States Patent Office, Vol 990, No 4, p 1374. January 22, 1980.

Descriptors: *Patents, *Water treatment, *Water quality control, *Water softening, Demineralization, Separation techniques, Ion exchange, Resins, Cations, Regeneration.

It has been discovered that a bed of a single thermally regenerable ion exchange resin may be operated in such a way that two zones established themselves within the bed. The first zone acts to remove predominantly the divalent cations from a treated fluid while removing only minor amounts of monovalent cations, and the second zone acts to remove predominantly the monovalent cations from the fluid. In connection with this dual-zone operation mode, it has been discovered that both zones of the resin bed may be regenerated by heating an aqueous fluid which is low in dissolved salts (e.g., water, deionized water, treated product fluid) and passing it through the entire bed in a countercurrent direction. During this countercurrent thermal regeneration monovalent cations fixed upon the resin of the second zone are exchanged for hydrogen cations in the hot regenerant fluid and the divalent cations fixed upon the resin of the first zone are exchanged for monovalent cations displaced from the second zone and hydrogen cations in the hot regenerant. (Sinha-OEIS).
W80-06565

WATER INTAKE SCREEN INSTALLATION AND METHOD OF STRAINING WATER,
FMC Corp., San Jose, CA. (Assignee).
W. M. Sutton.
U.S. Patent No. 4,186,091, 13 p, 13 Fig, 5 Ref; Official Gazette of the United States Patent Office, Vol 990, No 5, p 1754, January 29, 1980.

Descriptors: *Patents, *Water quality control, Flow, Streamflow, Separation techniques, Screens, Equipment, Aquatic life, Backwashing.

A water intake screen installation has a traveling water screen unit, that is positioned between a water intake and a stream of water flowing in a channel, to strain a quantity of water diverging from the channel stream towards the water intake. The screen unit includes an endless belt strainer in the form of a loop and a drive for revolving the

strainer. The strainer has a screening surface, that extends in a predetermined direction of stream flow in the channel and in an upwardly direction. Means are provided for directing a backwash current, through the screening surface, towards the stream of water flowing in the channel, at an elevation below the stream surface. Material, such as refuse and aquatic life, retained on the screening surface can be dislodged by the backwash current. This current forces such material backwardly from the screening surface, into the stream of water flowing in the channel, to be carried away therewith. Also disclosed is a method of straining water from a stream with the above described screening installation that enables water to be drawn from the stream without the removal of aquatic life and refuse. (Sinha-OEIS)
W80-06574

OIL COLLECTING APPARATUS,
G. Walin.
U.S. Patent No. 4,186,095, 6 p, 3 Fig, 14 Ref; Official Gazette of the United States Patent Office, Vol 990, No 5, p 1756, January 29, 1980.

Descriptors: *Patents, *Oil pollution, *Water quality control, Vortices, Rotational flow, Equipment, Separation techniques, *Oil recovery apparatus, Oiley water, Oil collection.

An apparatus, adapted to float on the surface for collecting oil contaminating the water surface, includes a submerged, roto-symmetrically shaped vortex chamber with inlet and outlet for the liquid, means for bringing the liquid within the vortex chamber into a horizontally rotating vortex movement, and an oil outlet tube arranged above the vortex chamber. Efficiency is considerably improved by a rotationally symmetrical stator arranged at the level of the water surface. The stator has a lower end surface which slopes downwards and inwards through the surface to the opening of the collecting cavity. The stator is arranged in a concentric manner with respect to the vortex chamber. The vortex chamber may comprise the interior of a hollow rotar having an upper threshold inlet. The invention also includes a method of separating oil from water. (Sinha-OEIS)
W80-06575

EFFECT OF GRASS BUFFER ZONE LENGTH IN REDUCING THE POLLUTION FROM LAND APPLICATION AREAS,
Soil Conservation Service, Rutherfordton, NC.
S. C. Bingham, P. W. Westerman, and M. R. Overcash.
Transactions of the American Society of Agricultural Engineers, Vol 23, No 2, p 330-335, 342, March-April 1980. 9 Fig, 4 Tab, 15 Ref.

Descriptors: *Water pollution control, *Runoff, *Agricultural runoff, *Farm wastes, On-site investigations, Sampling, Water pollution, Water pollution sources, Rainfall, Pollutants, Poultry, Manure, Vegetation, Grasses, Vegetation effects, Nutrients, Chemicals, Agriculture, *Grass buffer zones, Buffer zones.

A field study was conducted to determine the effect of grass buffer lengths in reducing pollutant concentration in rainfall runoff from land application areas. Evaluation of pollutant concentrations in runoff at various distances downslope from an area where caged-layer poultry manure was applied regularly, indicated that for the conditions of this experiment a buffer area length to waste area length ratio of 1.0 was usually required to reduce concentrations to those measured in runoff from a similar plot receiving no manure. Less buffer area is needed if concentrations greater than background conditions are acceptable. (Sims-ISWS)
W80-06622

EUTROPHICATION STRESS IN THE LITTORAL ZONE RESULTING FROM SHORELAND DEVELOPMENT,
Massachusetts Univ., Waltham. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5C.
W80-06690

DEVELOPMENT OF PROCEDURES TO EVALUATE SALINITY MANAGEMENT STRATEGIES IN IRRIGATION RETURN FLOWS,
Utah Water Research Lab., Logan.
V. A. Narasimhan, A. L. Huber, J. P. Riley, and J. J. Jurinak.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-104119, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Planning Series UWRL/P-80/03, June 1980. 79 p 31 Fig, 25 Tab. OWRT-B-147-UTAH (1), 14-34-0001-7194.

Descriptors: Salinity management, Irrigation return flow, *Water management(Applied), *Model studies, *Irrigation water, *Return flow, *Salinity, Surface-groundwater relationships, Drainage water, Groundwater, Agriculture, Dissolved solids, BSAM-Salt, Grand Valley(CO), Circleville and Sevier River Basin(UT).

The purpose of this research was to assess the state-of-the-art of hydrosalinity modeling in order to develop a practical management tool for predicting how the salt outflow from irrigated agriculture is affected by various farm management practices. This review indentified one of the major gaps in modeling as inadequate understanding and representation of the quatity and quality interrelationships between surface water, drainage water, and groundwater. The study also identified that a site specific equilibrium 'threshold concentration' (TC) of dissolved solids can be adequately estimated and represented in a model. Salt concentration above the TC would result in precipitation of salts within the soil profile. Higher TC values would, however, exist in the unsaturated soil. Based on these new concepts, salinity in the return flows was modeled as a composite of individual component outflows from the unsaturated zones and the saturated groundwater zone, and represents the interrelationships among surface water, drainage water, and groundwater. The model termed BSAM-SALT was tested using field data from irrigated areas in Grand Valley, CO, and the Circleville subbasin of the Sevier River Basin in Utah. A set of management runs was made to demonstrate the utility of the model in predicting the salt loading caused by irrigated agriculture in the Grand Valley, CO, area.
W80-06692

PHYSICOCHEMICAL TRANSFORMATIONS WITHIN EPHEMERAL STREAMBEDS RELATED TO SEWAGE EFFLUENT RELEASES,
Arizona Water Resources Research Center, Tucson.
For primary bibliographic entry see Field 5B.
W80-06695

IS YOUR BOREHOLE-WATER SAFE FOR DRINKING,
Pretoria Univ. (South Africa). Medical Faculty.
D. G. Steyn.
Farmer's Weekly (Mobeni Natal), p 26-28, March 1, 1978. 1 Fig.

Descriptors: *Boreholes, *Wells, *Saline water, *Public health, *Cattle, *Safety, Saline water intrusion, Saline water systems, Mineral water, Salts, Fluorides, Sulphates, Chlorides, Nitrates, Carbonates, Semiarid climates, Arid climates, South Africa, Feeds, Forages, Water analysis, Toxicity, Human pathology, Potable water, Rain water, Solar distillation, Droughts, Hazards.

The problems involved in the use of highly saline groundwater for drinking by cattle and humans are discussed. South Africa, in particular, has an acute problem with excessive amounts of mineral salts such as sulphate, chlorides, nitrates, bicarbonates, and fluorides in its semi-arid and arid regions. Sometimes grazing animals may not suffer ill-effects as a result of drinking highly saline water because of synergistic or antagonistic effects of one mineral upon another. Special attention should be directed to the reduction of cattle's intake of saline water by decreasing the amount of walking they must do to reach water, increasing the amount of green feed, by providing licks, and by considering the change in water salinity during droughts and winter months. Young stock should start out on less saline water before drinking only the mineralized water. Cases of suspected water poisoning should be investigated by a veternarian and water samples can be periodically analyzed by the Soil and Irrigation Research Institute, Pretoria. A farmer can easily estimate the salt content of his water by measuring the amount of residue remaining after evaporation of a liter of water. The symptoms of and protection against 'salt' water poisoning in humans and cattle are discussed in general terms. Saline water which is used for drinking by humans should be diluted with rainwater or solar distilled water. (Sidney-IPA)
W80-06714

PHOSPHORUS MANAGEMENT IN THE LAKE ERIE BASIN,
Corps of Engineers, Buffalo, NY. Buffalo District.
S. M. Yaksich, and R. R. Rumer, Jr.
Water Quality Information Bulletin, March 1980. 13 p, 8 Fig, 1 Tab.

Descriptors: *Phosphorus, *Lake Erie, *Water pollution, *Sediment control, *Water analysis, Inflow, Agricultural runoff, Runoff, Water quality, Soil conservation, Cultivation, Sewage disposal, Pollutants, Snowmelt, Water samplings, Great Lakes, New York, River basins, Water pollution sources, Phosphorus compounds, Chemical wastes, Lakes, Lake basins, Inflow, Soil erosion, Sediment discharge.

An abbreviated account is presented of an ongoing study being conducted by the U. S. Army Corps of Engineers under authority of Sections 108d and 108e of the Federal Pollution Control Act Amendments of 1972 (P. L. 92-500). This study is aimed at developing a plan for managing phosphorus (P) inputs into Lake Erie in order to restore lake quality. Pollutants enter Lake Erie from point (sewage collection systems) and diffuse (land runoff/tributary inflows) sources. Stream sampling data indicated increased P concentrations during/immediately following rains/snow melt when the stream contained high runoff. Reliable P loading estimates are best obtained during high flow events. Biological availability of sediment-bound P varies considerably (43-89%) with flow and between river basins. Control of diffuse/point sources of P in the basin is needed to meet the total P loading objective of 11,000 metric tons/year (MTY) set by the 1978 Great Lakes Water Quality Agreement. Reducing gross erosion via reduced tillage will reduce P loads to Lake Erie. Adoption of conservation tillage and no-till practices could reduce rural diffuse source total P loading by 2000-5000 MTY. Implementation of a demonstration program in a specific watershed in the basin is recommended. (Zielinski-IPA)
W80-06733

THE EQUITABLE APPROACH TO POLLUTION CONTROL MANAGEMENT IN THE THAMES ESTUARY,
Metropolitan Pollution Control-Thames Water, London (England).
For primary bibliographic entry see Field 5B.
W80-06772

A ONE-DIMENSIONAL STEADY-STATE, DISSOLVED-OXYGEN MODEL AND WASTE-LOAD ASSIMILATION STUDY FOR CLEAR CREEK, MONROE COUNTY, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
W. G. Wilber, C. G. Crawford, J. G. Peters, and F. P. Girardi.
Available from the OFSS, Box 25425, Fed. Ctr. Denver, CO 80225, $9.00 in paper copy, $3.50 in microfiche. Geological Survey open-file report 79-1533, October 1979. 63 p, 22 Fig, 14 Tab, 54 Ref.

Descriptors: *Model studies, *Dissolved oxygen, Waste assimilative capacity, *Water quality, *Indiana, Streams, Streamflow, Low flows, Reaeration, Water pollution, Waste water disposal, Waste water treatment, Biochemical oxygen demand, Nitrification, Ammonia, Nitrates, Nutrients, Math-

ematical models, *Monroe County(IN), *Clear Creek(IN), *Water pollution control, Water quality standards.

A digital model calibrated to conditions in Clear Creek, Monroe County, IN, was used to develop alternatives for future waste loadings that would be compatible with Indiana stream water-quality standards defined for two critical hydrologic conditions, summer and winter low flows. The Winston Thomas wastewater-treatment facility is the only point-source waste load affecting the modeled reach of Clear Creek. A new waste-water-treatment facility under construction at Dillman Road (river mile 13.78) will replace the Winston Thomas wastewater-treatment facility (river mile 16.96) in 1980. Natural streamflow during the summer and annual 7-day, 10-year low flow is zero, so no benefit from dilution is provided. The model indicates that ammonia-nitrogen toxicity is the most significant factor affecting the stream water quality during summer and winter low flows. The ammonia-nitrogen concentration of the wastewater effluent exceeds the maximum total ammonia-nitrogen concentration of 2.5 milligrams per liter for summer months (June through August) and 4.0 milligrams per liter for winter months (November through March) required for Indiana streams. Nitrification, benthic-oxygen demand, and algal respiration were the most significant factors affecting the dissolved-oxygen concentration in Clear Creek during the model calibration. Nitrification should not significantly affect the dissolved-oxygen concentration in Clear Creek during summer low flows when the ammonia-nitrogen toxicity standards are met. (USGS)
W80-06789

A ONE-DIMENSIONAL, STEADY-STATE, DISSOLVED-OXYGEN MODEL AND WASTE-LOAD ASSIMILATION STUDY FOR DUCK CREEK, MADISON, TIPTON, AND HAMILTON COUNTIES, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
C. G. Crawford, W. G. Wilber, and J. G. Peters.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $11.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-156, January 1980. 82 p, 35 Fig, 16 Tab, 56 Ref.

Descriptors: *Model studies, *Dissolved oxygen, *Waste assimilative capacity, Water quality, *Indiana, Streams, Streamflow, Low-flows, Reaeration, Water pollution, Waste water disposal, Waste water treatment, Biochemical oxygen demand, Nitrification, Ammonia, Nitrates, Nutrients, Mathematical models, *Duck Creek(IN), *Madison County(IN), *Tipton County(IN), *Hamilton County(IN), Water quality standards, *Water pollution control.

The Indiana State Board of Health is developing a State water-quality plan that includes establishing limits for wastewater effluents discharged into Indiana streams. A digital model calibrated to conditions in Duck Creek was used to develop alternatives for future waste loadings that would be compatible with Indiana stream water-quality standards defined for two critical hydrologic conditions, summer and winter low flows. The major point-source waste load affecting Duck Creek is the Elwood wastewater-treatment facility. Natural streamflow during the low flow is zero, so no benefit from dilution is provided. Natural reaeration at the low-flow condition (approximately 3 cubic feet per second), also low, is estimated to be less than 1 per day (base e at 20 Celsius). Consequently, the wasteload assimilative capacity of the stream is low. Effluent ammonia-nitrogen concentrations, projected by the Indiana State Board of Health, will result in stream ammonia-nitrogen concentrations that exceed the State ammonia-nitrogen toxicity standards (2.5 milligrams per liter from April to October and 4.0 milligrams per liter from November through March). The projected effluent ammonia-nitrogen load will also result in the present Indiana stream dissolved-oxygen standard (5.0 milligrams per liter) not being met. Benthic-oxygen demand may also affect stream water quality. During the summer low-flow, a benthic-oxygen demand of only 0.6 gram per square meter per day would utilize all the streams's available assimilative capacity. (USGS)
W80-06790

A ONE-DIMENSIONAL, STEADY-STATE DISSOLVED-OXYGEN MODEL AND WASTE-LOAD ASSIMILATION STUDY FOR LITTLE LICK AND BIG LICK CREEKS, BLACKFORD AND DELAWARE COUNTIES, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
J. G. Peters, C. G. Crawford, and W. G. Wilber.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $14.25 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-73, January 1980. 102 p, 44 Fig, 26 Tab, 54 Ref.

Descriptors: *Model studies, *Dissolved oxygen, *Waste assimilative capacity, Water quality, *Indiana, Streams, Streamflow, Low flows, Reaeration, Water pollution, Waste water disposal, Waste water treatment, Biochemical oxygen demand, Nitrification, Ammonia, Nitrates, Nutrients, Mathematical models, *Blackford County(IN), *Delaware County(IN), *Little Lick and Big Lick Creeks(IN), *Water pollution control, Water quality standards.

A digital computer model was used to predict alternatives for future waste loadings on Little Lick and Big Lick Creeks, Blackford and Delaware Counties, IN, that would be compatible with Indiana stream water-quality standards defined for two critical hydrologic conditions, summer and winter low flows. The model parameters included atmospheric reaeration, carbonaceous and nitrogenous biochemical-oxygen demand, and benthic-oxygen demand. The model was calibrated with data collected during three water-quality surveys at low flow. During these surveys, in-stream dissolved-oxygen concentrations averaged less than 3 mg/L, well below the State minimum requirement of 5.0 mg/L. The model indicated that these low concentrations were caused by high waste loadings, lack of dilution, low reaeration, and benthic-oxygen demand. The summer waste-assimilation study assumed that future reductions in discharge loadings would decrease carbonaceous and benthic decay and increase nitrogenous decay. This study indicated that projected effluent waste loads that would provide acceptable in-stream dissolved-oxygen concentrations are highly dependent on rates of nitrification. Ammonia toxicity became the limiting water-quality criterion at low nitrification rates. The winter waste-assimilation study indicated that projected dissolved-oxygen concentrations in Little Lick and Big Lick Creeks did not fall below the State standard. Owing to a lack of dilution, however, ammonia-nitrogen concentrations would violate in-stream toxicity standards in both Little Lick and Big Lick Creeks. (USGS)
W80-06791

A ONE-DIMENSIONAL, STEADY-STATE, DISSOLVED-OXYGEN MODEL AND WASTE-LOAD ASSIMILATION STUDY FOR EAST FORK WHITE RIVER, BARTHOLOMEW COUNTY, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
W. G. Wilber, J. G. Peters, and C. G. Crawford.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $9.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 79-1072, July 1979. 64 p, 24 Fig, 13 Tab, 53 Ref.

Descriptors: *Model studies, *Dissolved oxygen, *Waste assimilative capacity, *Water quality, *Indiana, Streams, Streamflow, Low flows, Reaeration, Water pollution, Waste water disposal, Waste water treatment, Biochemical oxygen demand, Nitrification, Ammonia, Nitrates, Nutrients, Mathematical models, *Bartholomew County(IN), *East Fork White River(IN), *Water pollution control, Water quality standards.

A digital model calibrated to conditions in East Fork White River, Bartholomew County, IN, was used to develop alternatives for future waste loadings that would be compatible with Indiana stream water-quality standards defined for two critical hydrologic conditions, summer and winter low flows. The model indicates that benthic-oxygen demand and the headwater concentrations of carbonaceous biochemical-oxygen demand, nitrogenous biochemical-oxygen demand, and dissolved oxygen are the most significant factors affecting the dissolved-oxygen concentration of East Fork White River downstream from the Columbus wastewater-treatment facility. The effect of effluent from the facility on the water quality of East Fork White River was minimal. The model also indicates that, with a benthic-oxygen demand of approximately 0.65 gram per square meter per day, the stream has no additional waste-load assimilative capacity during summer low flows. Regardless of the quality of the Columbus wastewater effluent, the minimum 24-hour average dissolved-oxygen concentration of at least 5 milligrams per liter, the State's water-quality standard for streams, would not be met. Ammonia toxicity is not a limiting water-quality criterion during summer and winter low flows. During winter low flows, the current carbonaceous biochemical-oxygen demand limits for the Columbus wastewater-treatment facility will not result in violations of the in-stream dissolved-oxygen standard. (USGS)
W80-06792

DEVICE FOR COLLECTING OIL FLOATING ON THE SURFACE OF WATER,
A. Kawamura.
U.S. Patent No 4,184,527, 9 p, 8 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 990, No 4, p 1240, January 22, 1980.

Descriptors: *Patents, *Water quality control, Water pollution treatment, Oil pollution, Oil spills, Equipment, Oily water, *Oil collecting device, Containment.

An improved device for collecting oil on the surface of water has a main body made of nonventalative and flexible sheet material and transformable from a flatly folded configuration to a three dimensional configuration and vice versa. It also has several hollow elements also made of nonventilative and flexible sheet material and inflatable to form a three dimensional rigid truss framework. These elements are adapted to cooperate with each other to forcibly transform the main body to a three dimensional configuration so that it can be internally loaded with a negative pressure developing oil sucking function. (Sinha - OEIS)
W80-06812

POST-PLUARG EVALUATION OF GREAT LAKES WATER QUALITY MANAGEMENT STUDIES,
Great Lakes Basin Commission, Ann Arbor, MI.
W. E. Skimin, R. W. Stevenson, and W. C. Sonzogni.
Report, July 1979, 129 p, 3 Tab, 18 Ref, 6 Append. EPA-78-D-X0430.

Descriptors: *Great Lakes, *Water Quality Management, Nonpoint Source Pollution, *Water Pollution Control, Point Source Control, Nonpoint Source Control, Best Management Practices, Phosphorus, *Land use, Evaluation, Projects.

The nonpoint source technical findings that have emerged since the completion of the PLUARG (Pollution from Land Use Activities Reference Group) report generally reaffirm the PLUARG conclusions. New information continues to support the PLUARG finding that toxic substances pollution, the most critical problem facing the Great Lakes, does not at present appear to be derived to any significant extent from land drainage. Atmospheric sources continue to be emphasized as an important source of many toxic contaminants. Through a comparison of PLUARG results with those of other studies, in particular the Lake Erie Wastewater Management Study (LEWMS) and the Basin Commission's Great Lakes Environmental Planning Study, as well as from a recently-held Great Lakes Phosphorus Management Strategies Workshop, it is recommended that a near-term phosphorus control strategy should call for complete implementation of the 1 mg/L phosphorus municipal effluent limitation for plants discharging

1 MGD or greater. Nonpoint source control should, at this time, be limited to those measures which can be achieved at little or no cost. (Sullivan-GLBC)
W80-06815

THE STATE OF ART IN THE USE OF CHLORINE DIOXIDE AND OZONE IN THE TREATMENT OF WATER,
Compagnie Intercommunale Bruxelloise des Eaux (Belgium).
W. J. Masschelein.
Water S. A., Vol 6, No 3, p 116-129, July, 1980. 14 Fig, 3 Tab, 32 Ref.

Descriptors: *Oxidation, *Chlorination, Chemical reactions, *Potable water, *Ozone, Chlorine, Treatment facilities, Biodegradation, Groundwater, Treatment, *Water treatment, Water supply, Water quality control, Water quality, Disinfection, Sodium compounds, Design criteria.

Basic ideas of practical developments in the use of oxidants at the Brussels' Intercommunal Waterboard (CIBE) were presented. This site is the location of an important designed and constructed raw water treatment plant that receives water from the river Meuse. The CIBE has put part of this plant into operation, of which the final design capacity will be 260,000 cubic meters per day. The water treatment process involves oxidation with chlorine and gaseous chlorine dioxide (performed in a reactor using hydrochloric acid-sodium chlorite reaction), coagulation, adsorption, flocculation, settling, stabilization, sedimentation, filtration, and ozonation. The resultant drinking water is mixed with various impounded groundwaters. Designing the plant to deliver water quality comparable with that of groundwater took over two years of study on appropriate chemical/physical processes. Theoretical/practical studies on the use of chlorine dioxide and the development of ozonation processes were discussed. Chlorine dioxide and ozone are oxidizing gases that must be generated on site. Treatment of water with both oxidants gave fewer biodegradable compounds than treatment with chlorine. Treatment plants using chlorine require proper design to limit excessive chlorine use and resultant formation of chlorinated products. (Zielinski-IPA)
W80-06852

ACID MINE WATERS IN SOUTH AFRICA AND THEIR AMELIORATION,
Navorsingsinstituut vir Grond en Besproeiing, Pretoria (South Africa).
J. G. Thompson.

Descriptors: control, Hydrogen ion concentrations, Acid-base equilibrium, Calcium compounds, Mine drainage, Mine acids, Acid streams, Acids, South Africa.

Thirty acid mine water samples, principally of coal mine origin or gold mine dumps were analyzed for pH, conductivity, and ferrous and ferric iron concentrations. Selected samples were analyzed prior to/following storage aging for 1-1.5 months at ambient temperatures under aerobic and anaerobic conditions. Neutralization studies were made using calcium hydroxide and calcium carbonate on selected samples to assess their efficiencies for water quality improvement. Oxidation of ferrous to ferric iron at ambient temperature using a minimum amount of 30% hydrogen peroxide was examined to allow determination of the lime requirement for neutralization of the acid waters. Although the form in which iron is present, ferrous or ferric, determines the pH at which iron can be removed by precipitation, it is the total acidity that determines the amount of hydrated lime required for full neutralization; an easy determination, following complete oxidation to ferric. Three principal stages are involved in acid water formation, the first two involving oxidation, and the third, hydrolysis. The latter being the most acid-forming, is promoted by ageing, indicating that prompt removal of water from mines will considerably reduce the amount of neutralizing agent needed. (Zielinski-IPA)
W80-06853

CONTAINMENT BOOM,
P. H. Langermann.
U.S. Patent No 4,188,155, 5 p, 6 Fig, 9 Ref; Official Gazette of the United States Patent Office, Vol 991, No 2, p 579, February 12, 1980.

Descriptors: *Patents, *Oil spills, *Water quality control, Oil pollution, Barriers, Floating, Equipment, *Containment booms.

A boom for the containment of oil spills and other debris on the surface of a body of water is formed of a curtain placed at the surface of the water in a generally vertical plane with a lower edge of the curtain being submerged below the surface. Floatation for the curtain is provided by a set of floats secured within pockets of a flexible material which is sewn to the curtain. Stiffening members in the form of rods are secured transversely to the curtain at regular intervals between the floats. Weights are positioned at the lower ends of the rods to amintain the vertical attitude of the curtain. Ports at the bottom of each pocket admit water to the interior of the pockets while air escapes through the stitching. Water entrapped within the pockets greatly increases the virtual mass of the boom for resisting sudden lurches and rolling movements induced by waves of water striking the boom. After using the boom, the water is permitted to drain out of the pockets via the ports to provide a light weight, portable boom that is readily stowed. (Sinha - OEIS)
W80-06947

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

EDUCATION TECHNIQUES AND PLANNING FOR WATER RESOURCES DEVELOPMENT - PHASE III,
Cornell Univ., Ithaca, NY. Dept. of Agricultural Economics.
D. J. Allee.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-222284, Price codes: A15 in paper copy, A01 in microfiche. Center for Environmental Research, Cornell University, Technical Completion Report, June 1980. 331 p, 16 Fig, 31 Tab, 108 Ref, 8 Append. OWRT-B-036-NY (1), 14-31-0001-4108.

Descriptors: *Water resources development, *Planning, *Education techniques, Flood plains, Information exchange, Public participation, University extension, Radio broadcasts.

An important aspect of the research reported is for the benefit of the university system itself. We have developed guidelines and insights, theory and practice, for university programs of informal education of community leaders, elected and appointed government officials, in water resources planning and management. Such results are of value to the many state and federal agencies engaged in planning and carrying out projects for the development and management of water resources and related land. Details are developed under the following subtopics: A Concept for Public Affairs Education Programs, Operation Flood Plain Management - publications and TV in public affairs education, An Adirondack Car Tour - to improve public understanding, Cayuga Lake Educational Leaflets - trying to organize a large lake, A history of the role of educational activities in conflict on the waters of Schoharie Creek and the Gilboa Dam, Radio as a tool for management of flood risk, Flood Risk Management Seminars - for community leaders, and The Synopsis Series - extracts of the fugitive literature for water professionals.
W80-06506

DROUGHT-INDUCED PROBLEMS AND RESPONSES OF SMALL TOWNS AND RURAL WATER ENTITIES IN COLORADO: THE 1976-1978 DROUGHT,
Colorado Univ., Boulder. Dept. of Economics.
For primary bibliographic entry see Field 2E.
W80-06561

DETERMINING OPERATING POLICIES FOR A WATER RESOURCE SYSTEM,
Birmingham Univ. (England). Dept. of Engineering Production.
For primary bibliographic entry see Field 4A.
W80-06628

SIMULATED EFFECTS OF GROUND-WATER DEVELOPMENT ON POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER, WEST-CENTRAL FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
W. E. Wilson, and J. M. Gerhart.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $19.00 in paper copy, $4.50 in microfiche. Geological Survey Open-File Report 79-1271 (WRI), 1980. 119 p, 41 Fig, 9 Tab, 44 Ref.

Descriptors: *Model studies, *Groundwater, *Water resources development, *Potentiometric level, *Florida, Aquifer characteristics, Water level fluctuations, Withdrawal, Water table, Projections, Water utilization, Irrigation, Municipal water, Phosphates, Mining, Hydrogeology, Computer models, West-central Florida, *Floridan aquifer.

A digital model of two-dimensional ground-water flow was used to predict changes in the potentiometric surface of the Floridan aquifer, 1976-2000, in a 5,938-square-mile area of west-central Florida. In 1975, ground water withdrawn from the Floridan aquifer for irrigation, phosphate mines, other industries, and municipal supplies averaged about 649 million gallons per day. Rates are projected to increase to about 840 million gallons per day by 2000. The model was calibrated under steady-state and transient conditions. Input parameters included transmissivity and storage coefficient of the Floridan aquifer; thickness, vertical hydraulic conductivity, and storage coefficient of the upper confining bed; altitudes of the water table and potentiometric surface; and ground-water withdrawals. Simulation of May 1976 to May 2000, using projected combined pumping rates for municipal supplies, irrigation, and industry (including existing and proposed phosphate mines), resulted in a rise in the potentiometric surface of about 10 feet in Polk County, and a decline of about 35 feet in parts of Manatee and Hardee Counties. The lowest predicted potentiometric level was about 30 feet below sea level. Predicted declines for November 1976 to October 2000 were generally 5 to 10 feet less than those for May 1976 to May 2000. (USGS)
W80-06787

A FISH MARK-RECAPTURE STUDY IN BOSKOP DAM, WESTERN TRANSVAAL,
Provincial Fish Inst., Lydenburg (South Africa).
B. S. Koch, and H. J. Schoonbee.
Water S. A., Vol 6, No 3, p 149-155, July, 1980. 9 Fig, 3 Tab, 20 Ref.

Descriptors: *Marking techniques, *Fish populations, *Statistical methods, *Estimating equations, *Aquatic weed control, Nets, Dams, Fish, Estimating, Fish barriers, Approximation method, Aquatic populations, Aquatic life, Fish management, Reservoirs, Aquatic weeds, Seines, Sampling, South Africa, Boskop Dam(South Africa).

A fish population study was made in Boskop Dam during September 1974, using the population estimate formulae of Schnabel and De Lury. Fish were caught with a 100 m by 3 m seine having a mesh size of 25 mm. A total of 34,244 fish were captured, with 33,459 marked and 1,794 recaptured, during the 18-day experiment. On the basis of the developed data and the population estimate approach used, estimation of the Cyprinid, Labes capensis, was found to be approximately 265,400 individuals; that of L. umbratus, 38,600; and that of the smallmouth yellow fish, Barbus holubi, 8,100. These estimates represented 96.1% of the total number of the larger fish species present in the dam; estimates for the three fish types being 81.7%, 11.9%, and 2.5%, respectively, of the total.

Representative population estimates of the common carp (Cyprimus carpio), the sharptooth catfish (Clarias gariepinus), and the smallmouth black bass (Micropterus dolomieu) could not be made, possibly due to their avoidance to net capture. The De Lury method gave the generally higher estimate for fish species examined. It is proposed that the Chinese grass carp be introduced to combat waterweed growth that interfered with the seining, after assuring its compatability with existing fish species. (Zielinski-IPA)
W80-06857

A MACRO-TO-MICRO FINITE ELEMENT PROCEDURE FOR PRODUCING WATER PLANNING MODELS,
Montana State Univ., Bozeman. Dept. of Industrial Engineering and Computer Science.
D. W. Boyd.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 2.157-2.166, 1980. 3 Fig, 1 Tab, 7 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Watersheds(Basins), *Runoff, *Water resources, *Model studies, Mathematical models, Finite element analysis, Analytical techniques, Methodology, Planning, Rivers, Drainage, Streamflow, Hydrology.

This paper presented the space and time continuum as a spectrum displaying a range of entry points into the modeling process. The conventional method is dropped in favor of an opposite approach; i.e., modeling is started at a relatively macro level and proceeds in the micro direction until reaching the desired 'building block' level. Thus, each level of modeling abstraction parallels conventional systems analysis techniques by which water resources systems are so conveniently analyzed--the more macro, the less theoretical abstraction. Simplicity and accuracy are achieved by letting the natural system do the integrating. Linear balance and linear regression equations, relating to finite elements of space and time, constitute the model at each descriptive level. The model is capable of simulating historical data to within the accuracy of the computer, of extending the data base, and of simulating postulated scenarios. An operational water planning model has been developed and used by the State of Montana. The linear format makes possible the linkage of submodels and models of interacting natural resource systems. Their simultaneous solution can be obtained with or without a common objective function. (See also W80-06858) (Sims-ISWS)
W80-06876

COMPUTER SIMULATION OF THE CUMULATIVE EFFECTS OF BRUSHLAND FIRE-MANAGEMENT POLICIES,
California Univ., Berkeley. Dept. of Forestry and Conservation.
T. M. Bonnicksen.
Environmental Management, Vol 4, No 1, p 35-47, 1980. 4 Fig. (California Water Resources Center Project UCAL-WRC-W-499). OWRT-A-058-CAL (4).

Descriptors: *Brushlands, *Watershed management, *Debris avalanches, *Burning, Rainfall, *Forest fires, Mathematical models, Vegetation effects, Vegetation regrowth, California.

A mathematical model simulates the cumulative volume of debris produced from brushland watersheds. Application of this model to a 1.76 km super 2 (0.678 = mi super 2) watershed along the flanks of the Central San Gabriel Mountains permits assessment of expected debris production associated with alternative fire-management policies. The political implications of simulated debris production are evaluated through a conceptual model that links interest groups to particular successional stages in brushland watersheds by means of the resources claimed by each group. It is concluded that in theory, a rotation burn policy would provide benefits to more interest groups concerned about southern California's brushland watersheds than does the current fire-exclusion policy. (Snyder-California)
W80-06938

6B. Evaluation Process

MEASURING ECONOMIC IMPACTS: THE APPLICATION OF INPUT-OUTPUT ANALYSIS TO CALIFORNIA WATER RESOURCES PROBLEMS,
California State Dept. of Water Resources, Sacramento.
W. O. Schink, and J. C. Fitz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-224066, Price codes: A09 in paper copy, A01 in microfiche. Bulletin Number 210, March 1980, 171 p, 7 Fig, 23 Tab, 229 Ref, 4 Append. OWRT-C-7513 (No. 6234) (1), 14-34-0001-6234.

Descriptors: *Input-output analysis, Mathematical models, *Economic impact, *Project planning, Evaluation, Economics, Direct benefits, Direct costs, Droughts, Income, *California, Multiregional input-output model, Standard industrial codes, *Impact study, Resource use multipliers, Applied water use, Industrial water use, *Water resources problems.

This study describes the development and application of a California statewide and twelve intrastate regional input-output (I-O) models. The statewide model, developed for 1976, consists of 156 sectors with emphasis on high water users, including 36 agricultural categories. The model is resource-oriented, providing estimates of direct and secondary employment, and of energy and water resource use for every million dollars of final demand sales. These resource uses vary by industry, depending on the industry, the resource considered, and the intensity of resource use by related industries. One application of this model was to project the economic impacts of water shortages resulting from the 1976-77 California drought, the most severe drought on record in the State. The model estimated the direct and indirect drought losses to be about $2 billion. In another application, the 12 regional models developed were used to estimate the economic impacts resulting from proposed California water-related projects. These projects include multi-purpose dams and reservoirs and other, single purpose, water-related projects providing ground water storage, water quality improvement facilities and water transportation facilities for agricultural and urban water users. In every instance, a significant portion (20-40 percent) of total benefits was realized in nonproject regions. Details of the models and their application, including microfiches of the complete statewide transactions, technical coefficients, and inverse tables, are presented for those interested in the technical aspects of the models or in making further applications.
W80-06560

WATER QUALITY INDEXING AND SCORING,
Weston (Roy F.), Inc., West Chester, PA.
R. O. Ball, and R. L. Church.
Journal of the Environmental Engineering Division, American Society of Civil Engineers, Vol 106, No EE4, Proceedings Paper 15617, p 757-771, August 1980. 7 Fig, 6 Tab, 20 Ref, 2 Append.

Descriptors: *Water quality, *Indexing, *Data transmission, Mathematical studies, Analytical techniques, Data collections, Information exchange, Information retrieval, Decision making, Environmental engineering, Water utilization, *Uniformity score.

The desirability of developing water quality indices, which has been frequently cited, was examined. The development of currently available indexes was reviewed, and a distinction was made between the indexing and scoring of water quality samples. It was pointed out that many indexes are, in fact, scoring methods, and that the mathematical basis for the scoring methods are not always consistent with the objectives of scoring. A general mathematical approach to scoring was described, and the necessity of considering the uniformity as well as the average quality of the water was described. The development and use of 'true' indices was briefly reviewed, and recommendations for future indexing approaches were presented. (Preece-ISWS)
W80-06756

LOGISTICS AND BENEFITS OF MATHEMATICAL MODELLING OF WATER RESOURCES,
International Inst. for Hydraulic and Environmental Engineering, Delft (The Netherlands).
M. B. Abbott.
In: Finite Elements in Water Resources, Volume 1; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 1.30-1.39, 1980. 4 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Water resources, *Mathematical models, *Water management(Applied), Benefits, Model studies, Floods, Droughts, Water utilization, Industrial water, Domestic water, Navigation, Agriculture, Logistics.

This paper is concerned with the resources that are currently committed to mathematical modeling services, the methods of management of these resources, and the benefits that they provide. The area of water resources provides so many applications for mathematical models that it has been possible to build up quite large departments and divisions dedicated to modeling work in this area. In these departments and divisions, modeling proceeds on an industrial basis very much as it does in other areas of the 'modeling industry'. The modeling industry as a whole is characterized by its dedication of nearly all investment to research, so that logistics and benefits tend to be perceived in terms of the logistics and benefits of research. This view has been taken also in the present paper, but some operational aspects of mathematical modeling for engineering applications have also been considered. In general it appears very likely that the area of mathematical modeling for water resources applications will continue to grow strongly during the 1980s, but at the same time it will be necessary to invest so heavily in research that most growth will probably be relatively profitless. (See also W80-06858) (Humphreys-ISWS)
W80-06860

UTE SELF-DETERMINATION IN SETTING TRIBAL RESOURCE DEVELOPMENT POLICY,
Utah Center for Water Resources Research, Logan.
H. Fullerton, M. McKee, and R. D. Hansen.
Available from Mr. Clifford Duncan, Ute Tribal Museum, Box 241, Ft. Duchesne, UT 84026. Report, July 1980, 158 p, 18 Fig, 14 Tab, 7 Append. OWRT-C-7028-(No 6204) (5), 14-34-0001-6204.

Descriptors: *Water resources development, *Indian reservations, *Utah, *Project planning, Water policy, Available water, Water supply, Economic impact, Social impact, Employment, Legal aspects, Evaluation, *Ute Indian Tribe(UT).

The Ute Indian Tribe of northeastern Utah has large land holdings rich in water and energy resources. Revenues from these sources have created capital that can potentially be used by the Tribe to further develop its resources and expand its agricultural and business enterprises. Realities, however, complicate this simple scenario in that the Tribal goals are broader than pure economic gain and that increased incomes may mean sacrifices in terms of these other goals. The Tribe faces the problem of how best to develop its water resources in a way that best meets its multiplicity of needs. The research team worked with the Utes to articulate their resource development goals, to operationalize those goals through the identification of measureable indicators, to identify promising development policies, to predict what those policies would achieve through changing the indicators, and to set before the Utes the trade offs among the goals. The procedures used in working with the Indians are described. The results were used to

construct and use a linear programming model to identify Ute-specific development policies with their impacts and the trade offs among them. The model provides a framework that the Tribe can use to assess the alternatives for developing its water resources.
W80-06935

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

BAYESIAN ANALYSIS OF ENERGY PRICES ON IRRIGATION,
Arizona Univ., Tucson. Dept. of Agriculture Economics.
For primary bibliographic entry see Field 3F.
W80-06505

MANAGING SMALL WATER SYSTEMS: A COST STUDY. VOLUME I,
Municipal Environmental Research Lab., Cincinnati, OH. Drinking Water Research Div.
R. G. Stevie, R. M. Clark, J. Q. Adams, and J. I. Gillean.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-126402, Price codes: A10 in paper copy, A01 in microfiche. EPA-600/2-79/147a, September 1979. 198 p, 101 Fig, 13 Tab, 9 Ref. 68-03-2071.

Descriptors: *Management, *Water works, *Operating costs, *Cost analysis, *Statistics, *Mathematical studies, Water distribution, Water treatment, Utilities, Water supply, Regulation, Capital costs, Costs, Maintenance costs, Economic impact, Safe Drinking Water Act.

An analysis of 23 selected small water utilities located in EPA regions III, V and VI was conducted. A summary is presented of the small utilities data, a statistical evaluation of factors affecting the cost of water supply, and an evaluation of the cost impact of add-on technologies to satisfy Safe Drinking Water Act requirements. The data were collected over a 10-year period on 4 major operating/maintenance cost components (support services, acquisition, treatment, and distribution), 3 significant subelements (chemical, payroll, and power), and capital costs associated with depreciation and interest. Revenue-producing water served as the basis for all calculations. Individual/comparative analyses of cost variables showed distribution as the most significant cost component (though other components showed greater cost acceleration), and labor cost was a significant part of total operating/maintenance costs (often more than doubling over the decade). A mathematical relationship was developed relating labor cost and productivity to a measure of capital cost and productivity. On the average, projected 1980 costs for the 23 utilities will increase less than 5% to meet drinking water standards, but extreme increases greater than 100% can occur. Volume II contains the basic data from all 23 utilities studied. (Zielinski-IPA)
W80-06644

ESTIMATING WATER TREATMENT COSTS. VOLUME 2. COST CURVES APPLICABLE TO 1 TO 200 MGD TREATMENT PLANTS,
Culp/Wesner/Culp, Santa Ana, CA.
R. C. Gumerman, R. L. Culp, and S. P. Hansen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-139827, Price codes: A23 in paper copy, A01 in microfiche. EPA-600/2-79-162b, August 1979. 506 p, 232 Fig, 186 Tab, 11 Ref. 68-03-2516.

Descriptors: *Costs, *Water treatment, *Mathematical models, *Computer programs, Regulations, Pollutants, Asbestos, Viruses, Design, Water quality, Chlorine, Construction costs, Water supply, Filters, Sludge disposal, Facilities, Pumps, Energy.

This volume (of a 4-volume study presenting construction and operation and maintenance cost curves for 99 unit processes especially applicable individually, or in combination, to removal of National Interim Primary Drinking Water Regulations contaminants) discussed 72 unit processes particularly suited to large (1-200 mgd (3785-757,000 cu m/d)) water supply treatment systems, presents cost (October 1978 dollars) curves, and includes enhanced virus and asbestos removal information. Conceptual designs were formulated for each unit process, and used to develop construction costs (presented in tabular form in eight categories: excavation and sitework, manufactured equipment, concrete, steel, labor, pipe and valves, electrical and instrumentation, and housing). Construction costs are also plotted against the most appropriate design parameter for the process (lbs/day for chemical feed systems; sq. ft. surface area for filters). Operation/maintenance needs were determined individually for energy, maintenance material, and labor. Volume 1 summarizes the 4 volumes of this report and demonstrates the use of the cost curves; Volume 3 includes cost curves for small (2500 gpd - 1 mgd) water supply treatment systems; Volume 4 is a computer program user's manual for the cost curves in the overall report. (Zielinski-IPA)
W80-06645

WATERPLAN: A COMPREHENSIVE WATER MANAGEMENT FRAMEWORK FOR THE U.S. VIRGIN ISLANDS,
Caribbean Research Inst., St. Thomas. Water Resources Research Center.
R. W. Peebles, A. E. Pratt, and H. H. Smith.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-106874, Price codes: A04 in paper copy, A01 in microfiche. Technical Report No 2, 1979. 43 p, 2 Fig, 5 Tab, 25 Ref. OWRT-A-999-VI (2), 14-34-7100.

Descriptors: *Virgin Islands, Planning, *Water management(Applied), Water supply, Water demand, Available water, Pricing, Social aspects, Waste water treatment.

Current and future supplies and costs are discussed in the context of island water demands; strong emphasis is placed on opportunities to maximize self-sufficiency and reliability in water supply through careful use of water and a sensible mix of natural and manufactured sources of water. Water law, administrative procedures for the management of water and agency responsibilities are discussed. Several options for both short and long-term improvement of the water situation are presented. Among the conclusions are that water is and always will be a scarce commodity in the USVI, a fundamental change in policy is needed to turn from dependence on manufactured and imported water as basic public supply, lack of accountability by a single agency leads to a failure to implement programs, the present pricing structure should be changed, and a reduction in present per capita demand should be made.
W80-06696

6D. Water Demand

PUMPAGE OF WATER IN LOUISIANA, 1975,
Geological Survey, Baton Rouge, LA. Water Resources Div.
G. T. Cardwell, and W. H. Walter.
Louisiana Department of Transportation and Development, Office of Public Works Water Resources Special Report No 2, 1979. 15 p, 3 Fig, 4 Tab, 22 Ref.

Descriptors: *Water utilization, *Water resources, *Louisiana, *Water supply, Water utilization, Irrigation water, Industrial water, Groundwater, Surface waters, Withdrawal, Aquifers, Chicot aquifer(LA).

In 1975 an estimated 11,700 million gallons per day of water was pumped for various uses in Louisiana; 10,200 million gallons per day was pumped from surface-water sources and 1,560 from ground water. Two-thirds of the surface-water withdrawals were from the Mississippi River, mainly for industrial use, and about one-half of the ground water was pumped from the Chicot aquifer in southwestern Louisiana, mainly for irrigation. Total withdrawal use of water in the State increased by 29 percent, 1970-75. Use of surface water increased by 35 percent while use of ground water increased by only 2 percent. (USGS)
W80-06527

AN EMPIRICAL ASSESSMENT OF CONJUNCTIVE USE AND WATER PRICING POLICY,
California Univ., Davis. Dept. of Agricultural Economics.
B. D. Gardner, R. E. Howitt, C. V. Moore, and V. H. Scott.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-222839, Price codes: A02 in paper copy, A01 in microfiche. California Water Resources Center, University of California, Technical Completion Report, August 1980, 12 p. (California Water Resources Center Project UCAL-WRC-W-526). OWRT-B-187-CAL (5).

Descriptors: *Model studies, *Economics, Hydrologic models, Surface waters, Groundwater, Overdraft, *Conjunctive use, Economic efficiency, Water management(Applied), *Water demand, Available water, Pricing, Evaluation, *California, Yolo County(CA), Kern County(CA).

Linear quadratic control models were utilized to analyze problem of conjunctive use of surface and groundwater in two California settings: (1) Yolo County, where a finite element hydrologic model was developed to provide physical data for an economic model, and (2) Kern County where groundwater overdrafting has been a long standing issue. The principal thrust of the Yolo study was to determine the economic efficiency of spatial surface and groundwater allocations and the efficiency of inter-temporal groundwater decisions, given the common property problems arising from uncontrolled groundwater use. The Kern study had two primary thrusts: (1) to model groundwater demands and supplies and determine the optimal steady state depths of water tables in various areas and the factors influencing the optimal steady state, and (2) to model water quality linkages with quantity in order to derive implications for efficient water allocation, management, and control. Study results show clear evidence of significant resource misallocation of water both spatially and temporally. Severe impediments to efficient water mobility exist in legal and administrative allocation processes. Some control over groundwater use is shown to be needed and some state policy governing groundwater use is recommended. Implementation is required, however, only in a limited number of critical groundwater basins in the near future. (Snyder-California)
W80-06556

WATERPLAN: A COMPREHENSIVE WATER MANAGEMENT FRAMEWORK FOR THE U.S. VIRGIN ISLANDS,
Caribbean Research Inst., St. Thomas. Water Resources Research Center.
For primary bibliographic entry see Field 6C.
W80-06696

6E. Water Law and Institutions

THE CHICAGO REGION'S VALUABLE WATER RESOURCES,
Keifer and Associates, Inc., Chicago, IL.
C. J. Keifer.
Journal of the Water Resources Planning and Management Division, American Society of Civil Engineers, Vol 106, No WR2, Proceedings Paper 15569, p 541-559, July 1980. 11 Fig, 17 Ref, 1 Append.

Descriptors: *Water resources, *Illinois, *Lake Michigan, *Water supply, Aquifers, Great Lakes, Water rights, Water requirements, Water management(Applied), Runoff, Regulation, Rivers, Forecasting, Groundwater, Consumptive use, Diversion, Planning, Utilities, *Chicago(IL).

Solutions of the complex water supply problems of the Chicago metropolitan area were discussed in

detail. Limitations in the use of Lake Michigan water imposed by the U.S. Supreme Court's decrees of 1930 and 1967; the overpumping and depletion of the deep sandstone aquifers; the increasing demands caused by the extensive growth of the metropolitan area; and the other uses such as lockages, leakages, navigation makeup, stormwater runoff, and dilution water needed for waterway quality all add to the complexity of the water supply of this metropolitan region. Computer analyses reveal that projected future water supply demands will conflict with other uses of the 3,200-cfs allowable Lake Michigan water source. However, extensive studies show that the potential water supply deficit can be mitigated: (1) with implementation of conservation measures required by the Illinois Division of Water Resources in its water allocation order; (2) with completion and startup of the extensive pollution control facilities of the Metropolitan Sanitary District of Greater Chicago; and (3) upon success of the petition to the U.S. Supreme Court to change the Lake Michigan diversion accounting procedures. (Humphreys-ISWS)
W80-06502

WATER FOR THE VALLEY OF THE SUN,
Water and Power Resources Service, Denver, CO. Div. of Planning Technical Services.
W. W. Reedy.
Journal of the Water Resources Planning and Management Division, American Society of Civil Engineers, Vol 106, No WR2, Proceedings Paper 15544, p 477-492, July 1980. 5 Fig, 14 Ref, 1 Append.

Descriptors: *Arizona, *Water resources development, *History, Irrigation, Water quality, Hydroelectric power, Indian reservations, Federal Reclamation Law, Water supply, Groundwater, *Central Arizona Project, *Salt River(AZ).

Water development in the Salt River Valley of south-central Arizona has progressed from the simple irrigation canals of prehistoric Hohokam Indians to a complex network of public and private facilities supplying agricultural and urban needs. In the modern era, several private canals were built prior to 1900, but construction of a dam to store spring runoff was beyond private financing capability. Federal financial assistance through the Reclamation Act of 1902 made possible the construction of Theodore Roosevelt Dam and other needed facilities. The Salt River Valley Water Users Association, which took over operation of the project in 1917, has built five more dams, three of which have appurtenant hydroelectric power plants, three steam-electric generating plants, and 250 groundwater wells. Local surface water supplies are essentially developed and the groundwater reservoir is being rapidly depleted. The Federal Central Arizona Project, now under construction, will bring water from the Colorado River to help relieve the imbalance between demand and supply. The need for water continues in the Valley of the Sun and only through the efforts of its citizens will the valley continue to prosper and grow. (Humphreys-ISWS)
W80-06503

GROUND-WATER SURFACE-WATER CONFLICTS,
Resource Consultants, Inc., Fort Collins, CO.
M. W. Bittinger.
Journal of the Water Resources Planning and Management Division, American Society of Civil Engineers, Vol 106, No WR2, Proceedings Paper 15567, p 467-475, July 1980. 13 Ref, 1 Append.

Descriptors: *Groundwater, *Conjunctive use, *Water rights, *Colorado, *Surface waters, Aquifers, Streamflow, Water resources development, Water law, Aquifer systems, Aquifer management, Legislation.

Users of surface water and groundwater from hydraulically connected sources (referred to as stream-aquifer systems) are on a collision course in many areas. The groundwater engineer or hydrologist has made considerable progress in the past 40 years in understanding and mathematically simulating responses in stream-aquifer systems. But unfortunately, development and use of water from many stream-aquifer systems preceded the availability and use of such modeling techniques. Further, law and other socioeconomic factors make implementation of conjunctive use plans extremely difficult. Many state water laws do not address the potential conflict between surface-water and groundwater users. Some states apply one water-rights doctrine to groundwater and a different one to surface water in stream-aquifer systems although the same water is involved in both. One state (Colorado) has passed legislation specifically addressing the problem of water rights in stream-aquifer systems. The 10 years of experience with this legislation could be helpful to other state legislatures and water administrators. (Humphreys-ISWS)
W80-06504

CITIZEN'S HANDBOOK, VIRGIN ISLAND WATER LAW,
Caribbean Research Inst., St. Thomas. Water Resources Research Center.
G. Janov.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-106882, Price codes: A03 in paper copy, A01 in microfiche. August, 1979. 22 p, 10 Append. OWRT-A-999-VI (1), 14-34-7100.

Descriptors: *Water law, *Virgin Islands, Legislation, Water users, *Water permits, Legal aspects, Water policy.

A short summary of the history of water law in the U.S. Virgin Islands is presented as an introduction to this easily understood manual for water users in this water scarce region. Appropriation permits then are covered in a section detailing who needs to apply, the procedures one should follow in applying and the consequences of the issuance of a permit. Then special rules relating to the digging, plugging, sealing and capping of wells are discussed. Copies of all application forms referred to in the narrative are in the appendicies.
W80-06686

WATERPLAN: A COMPREHENSIVE WATER MANAGEMENT FRAMEWORK FOR THE U.S. VIRGIN ISLANDS,
Caribbean Research Inst., St. Thomas. Water Resources Research Center.
For primary bibliographic entry see Field 6C.
W80-06696

6G. Ecologic Impact Of Water Development

GEOTHERMAL AREAS IN NEVADA - THE DISTRIBUTION OF VASCULAR PLANTS NEAR THE THERMAL SPRINGS SURVEYED,
Nevada Univ. System, Reno. Desert Research Inst.
For primary bibliographic entry see Field 2I.
W80-06936

7. RESOURCES DATA

7A. Network Design

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN NEW MEXICO--FISCAL YEAR 1979,
Geological Survey, Albuquerque, NM. Water Resources Div.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $10.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-408, March 1980. 77 p, 28 Fig, 12 Ref.

Descriptors: *Water resources, *New Mexico, *Projects, *Data collections, Surface waters, Groundwater, Network design, Available water, Water quality, Publications, Programs, *U.S. Geological Survey.

This is the second of an annual series of reports in which the program of the New Mexico District, U.S. Geological Survey, Water Resources Division, is summarized. This report should be useful to cooperating agencies and to the users of water data in that it summarizes and gives the status of the basic data collection program and all current studies of the Water Resources Division in New Mexico. At the end of fiscal year 1979 the Mexico District had 34 active projects, had released 10 reports during the year, and had answered thousands of requests for water-related information. (USGS)
W80-06804

7B. Data Acquisition

A SNOWMELT AND WATER EQUIVALENT GAUGE FOR BRITISH CONDITIONS,
University Coll. of Wales, Aberystwyth. Dept. of Geography.
E. A. Waring, and J. A. A. Jones.
Hydrological Sciences Bulletin, Vol 25, No 2, p 129-134, June 1980. 2 Fig, 1 Tab, 16 Ref.

Descriptors: *Snowmelt, *Water equivalent, *Precipitation gages, *Instrumentation, Measurement, Foreign research, Snowfall, On-site tests, Snowfall-snowmelt gage design, *United Kingdom.

A combined snowfall and snowmelt gage was designed and tested to meet the particular conditions commonly found in the British Isles where snow covers tend to be relatively shallow and short-lived. Current measurement techniques in Britain tend to underestimate both frequency and amount of snowfall. The gage identifies and measures snow cover by a hydraulic weighing system biased to shallow covers. Snowmelt and rainfall are measured via a central drainage system. Both measurements are attached to a data logger and used in a telemetry network. The gage performed well in a variety of snow conditions at an upland site during periods when a standard raingage was frequently capped by heavy, wet snow or buried by deep snow. The water equivalent measured by the weighing gage was found to be not significantly different from that on the surrounding ground surface at the 95 per cent confidence level. Once calibrated, the gage requires very little maintenance apart from changing the charts weekly. (Humphreys-ISWS)
W80-06480

DETERMINATION OF ACTUAL EVAPORATION FOR HYDROLOGICAL BUDGETS USING INFRA-RED THERMOMETRY BY REMOTE SENSING (DETERMINATION DE L'EVAPORATION REELLE DANS LES BILANS HYDROLOGIQUES PAR LA TELEDETECTION EN THERMOGRAPHIE INFRAROUGE),
Centre de Recherches, Avignon (France). Station de Bioclimatologie.
For primary bibliographic entry see Field 2D.
W80-06482

EXTENSION OF LABORATORY-MEASURED SOIL SPECTRA TO FIELD CONDITIONS,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
E. R. Stoner, M. F. Baumgardner, R. A. Weismiller, L. L. Biehl, and B. F. Robinson.
Soil Science Society of America Journal, Vol 44, No 3, p 572-574, May-June 1980. 4 Fig, 20 Ref.

Descriptors: *Soil moisture, *Remote sensing, *Spectroscopy, *Glacial soils, Measurement, Analytical techniques, On-site tests, Prairie soils, Forests, Grasslands, Laboratory tests, Methodology, Wavelengths, Reflectance, Glacial soils, Testing procedures, Soils, Loam, Clay loam, Silts, Data collections, Crop residue, Spectroradiometry.

Spectral responses of two glaciated soils, Chalmers silty clay loam and Fincastle silt loam, formed under prairie grass and forest vegetation, respectively, were measured both in the laboratory under controlled moisture equilibria, and in the field under various moisture and crop residue condi-

tions. An Exotech Model 20C spectroradiometer was used to obtain spectral data in the laboratory under artificial illumination. Reflectance measurements ranged from 0.52- to 2.32-micrometer in 0.01 micrometer increments. Asbestos tension tables were used to maintain a 0.10-bar moisture equilibrium following saturation of crushed, sieved soil samples. The same spectroradiometer was used outdoors under solar illumination to obtain spectral response from dry and moistened field plots with and without corn residue cover, representing the two different soils. Results indicate that laboratory-measured spectra of moist soil are directly proportional to the spectral response of that same field-measured moist bare soil over the 0.52- to 1.75-micrometer wavelength range. The magnitudes of difference in spectral response between identically treated Chalmers and Fincastle soils are greatest in the 0.6- to 0.8-micrometer transition region between the visible and near infrared, regardless of field condition or laboratory preparation studied. (Humphreys-ISWS)
W80-06489

THE ESTIMATION OF RAIN FROM SATELLITE-BORNE MICROWAVE RADIOMETERS,
McGill Radar Weather Observatory, Ste. Anne de Bellevue (Quebec).
S. Lovejoy, and G. L. Austin.
Quarterly Journal of the Royal Meteorological Society, Vol 106, No 448, p 255-276, April 1980. 5 Fig, 7 Tab, 53 Ref.

Descriptors: *Rainfall, *Remote sensing, *Satellites(Artificial), Measurement, Microwaves, Instrumentation, Equipment, Data processing, Clouds, Rain, Temperature, Attenuation, Spatial distribution, Temporal distribution, Weather, Meteorology, Radiometry, Radiometers.

Recent advances in satellite-borne microwave radiometry have led to interest in their use for rainfall amount estimation. The potential accuracy of such techniques was investigated in detail, and was estimated to be about plus or minus 70% for rainfall rate estimates even when many wavelengths are used. The effects of the low spatial and temporal resolution of the most recently launched microwave radiometer (on Nimbus 7) also were investigated using radar-based computer simulations. The effects were shown to produce r.m.s. errors of plus or minus 200, plus or minus 310%, respectively, yielding a total error of plus or minus 370% for independent processes. (Sims-ISWS)
W80-06497

QUANTITATIVE INTERPRETATION OF GREAT LAKES REMOTE SENSING DATA,
National Aeronautics and Space Administration, Cleveland, OH. Lewis Research Center.
D. F. Shook, J. Salzman, R. A. Svehla, and R. T. Gedney.
Journal of Geophysical Research, Vol 85, No C7, p 3991-3996, July 20, 1980. 8 Fig, 1 Tab, 15 Ref.

Descriptors: *Water quality, *Great Lakes, *Remote sensing, *Water properties, *Lake Erie, *Lake Superior, Lakes, Instrumentation, Measurement, Reflectance, Analytical techniques, Optical properties, Wavelengths, Mathematical models, Infrared radiation, Suspended solids, On-site investigations, On-site tests.

Remote sensing was applied in the past to the surveillance of Great Lakes water quality, but it was only partially successful because of the completely empirical approach taken in relating the multispectral scanning data at visible and near-infrared wavelengths to water parameters. Any remote sensing approach using water color information must take into account; (1) the existence of many different organic and inorganic species throughout the Great Lakes, (2) the occurrence of a mixture of species in most locations, and (3) spatial (inter- and intralake as well as vertical) variations in types and concentrations of species. The radiative transfer model provides a potential method for an orderly analysis of remote sensing data and a physical basis for developing quantitative algorithms. Predictions and field measurements of volume reflectances were presented that clearly show the advantage of using a radiative transfer model. Spectral absorptance and backscattering coefficients for two inorganic sediments were reported. Because the atmospheric effects were minimal--remote sensing data were recorded at very low altitude (less than 500 ft)--they were not considered in this discussion. (Humphreys-ISWS)
W80-06501

RECENT AUTOMATION CHANGES IN MODEL VELOCITY ANALYSES AND DATA ACQUISITION BY MINIATURE PRICE METERS,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
D. L. Durham, H. C. Greer, III, and K. A. Turner.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A072692, Price codes; A04 in paper copy, A01 in microfiche. Miscellaneous Paper HL-79-6, May 1979. 62 p, 4 Tab, 7 Ref, 4 Append.

Descriptors: *Automation, *Current meters, *Velocity, Flow rates, Hydraulic models, *Tides, Tidal water, Price meters, Testing, Little River Inlet(SC).

Recent automation of acquisition and analysis of velocity data collected by Price meters is presented in this report. Recent improvements to the fiber optic elements for the Price meter and development of electronic/binary counting circuits are discussed. A general description of a portable digital recording system and detailed documentation of its operating procedures are presented. In addition, documentation is provided for (1) the format of the output magnetic tape generated by the portable digital recording system, and (2) computer (H635) programs for reading and demultiplexing data on magnetic tape, editing and scaling velocity data, and reducing velocity data to a standard format for use in analysis programs and technical reports. (WES)
W80-06542

A SIMPLE, INEXPENSIVE AUTOMATED DATA-HANDLING SYSTEM FOR INDUCTIVELY-COUPLED PLASMA ANALYSIS,
Geological Survey, Doraville, GA. Water Resources Div.
B. E. Jones, G. P. Stein, and H. E. Taylor.
Jarrell-Ash Plasma Newsletter, Vol 2, No 3, p 9, July 1979. Published by Fisher Scientific Company, Waltham, Massachusetts, 2 Ref.

Descriptors: *Data processing, *Computers, *Water quality, *Water analysis, Spectrometers, Analytical techniques, *Spectrochemical analysis, *Inductively-coupled plasma.

A problem in inductively-coupled plasma emission spectrometric analysis is handling the vast amount of data produced during routine water-quality analysis. A rapid, efficient sample system is described for utilizing a magnetic-tape cassette system to log raw data from an emission spectrometer and transfer it to a data-processing computer for data reduction. (USGS)
W80-06576

A NUMERICAL-EXPERIMENTAL STUDY OF PARSHALL FLUMES,
National Bureau of Standards, Washington, DC. National Engineering Labs.
R. W. Davis, and S. Deutsch.
Journal of Hydraulic Research, Vol 18, No 2, p 135-152, 1980. 8 Fig, 6 Ref.

Descriptors: *Venturi flumes, *Discharge measurement, *Model studies, *Open channel flow, Discharge(Water), Flowmeters, Mathematical models, Numerical analysis, Measurement, Laboratory tests, Hydraulic models, Rating curves, Velocity, Water levels, Profiles, Data collections, Flow profiles, Parshall flumes.

Parshall flumes are commonly used devices for the measurement of flow rates in open channels such as sewers and irrigation ditches. The operation of these flumes in 'nonstandard' situations, e.g., when faced with distorted upstream velocity profiles or when placed in sloping channel beds, is poorly understood. This paper presented numerical solutions for the flow through Parshall flumes utilizing a three-dimensional, free-surface finite difference code. The effects on flume operation of channel slope, upstream velocity profile distortions, and flume geometry changes were assessed. Experimental results were obtained for a Parshall flume with a 15.2 cm (6 in.) throat width. Comparisons of experimental and numerical data on important features of the flume flowfield were shown to be good. (Humphreys-ISWS)
W80-06608

STANDARDIZATION OF TESTING METHODS FOR ICE PROPERTIES,
International Association for Hydraulic Research, Delft (Netherlands).
For primary bibliographic entry see Field 2C.
W80-06609

OBSERVATION OF WAVELIKE MOTION OF THE GASPE CURRENT,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
For primary bibliographic entry see Field 2L.
W80-06619

MICROWAVE BRIGHTNESS OF POLAR FIRN AS MEASURED BY NIMBUS 5 AND 6 ESMR,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
A. T. C. Chang, B. J. Choudhury, and P. Gloersen.
Journal of Glaciology, Vol 25, No 91, p 85-91, 1980. 2 Fig, 3 Tab, 19 Ref.

Descriptors: *Microwaves, *Temperature, *Remote sensing, *Glaciers, Satellites(Artificial), Model studies, Mathematical models, Numerical analysis, Albedo, Absorption, Snow, Snow cover, Glaciology, *Brightness temperatures, Radiometers.

The microwave emission from a half-space medium characterized by coordinate dependent scattering and absorbing centers has been calculated by numerically solving the radiative transfer equation by the method of invariant imbedding. A Mie scattering phase function and surface polarization have been included in the calculation. Also included are the physical temperature profile and the temperature variation of the index of refraction for ice. Using published values of grain-size and temperature-profile data of polar firn, the brightness temperature has been calculated for the 1.55 cm and 0.8 cm wavelengths. For selected regions in Greenland and Antarctica, the results of the authors' calculations were in reasonable agreement with the observed Nimbus-5 and Nimbus-6 ESMR data. (Sims-ISWS)
W80-06666

PORTABLE ENVIRONMENTAL DATA LOGGER AND SENSORS,
Arizona Univ. at Little Rock. Dept. of Electronics and Instrumentation.
R. A. Sims.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-103095, Price codes: A04 in paper copy, A01 in microfiche. Arkansas Water Resources Research Center, University of Arkansas, Fayetteville Publication No 71, 1980. 50 p, 26 Fig, 6 Tab. OWRT-A-023-ARK (2), 14-31-0001-7008.

Descriptors: *Data collections, *Instrumentation, *Wetlands, Environmental effects, Temperature, Humidity, Wind velocity, Water table, Inflow, Surface waters, Vegetation, Growth rates, Reproduction, Data processing, Magnetic tape.

An instrumentation and recording package and several transducers were constructed and used to collect data on the environmental parameters thought to affect wetland vegetation growth and reproduction. These parameters were temperature, humidity, wind velocity, depth of water table, and

amount of surface water. The data were collected four times a day and recorded on magnetic cassette tape that could record for as long as 90 days. The tapes were read and the data were converted to engineering units by a microcomputer-based instrument constructed for that purpose.
W80-06691

A TIDAL-POWERED WATER SAMPLER,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
D. W. Hayes, S. D. Harris, and R. S. Stoughton.
Limnology and Oceanography, Vol 25, No 4, p 761-764, July 1980. 3 Fig, 1 Tab. DOE AT(07-2)-1.

Descriptors: *Water sampling, *Instrumentation, *Tidal effects, *Sea water, Sampling, Methodology, Testing procedures, Automation, Estuaries, Tidal-powered water sampler.

A tidal-powered compositing water sampler has been designed to operate over a wide range of tides. It can sample water over long periods without attention and can be made from inexpensive hardware components and two check valves. The working principle of the sampler is to use the reduction of pressure by the falling tide and the stored pressure from the previous high tide to pump water into a collection bottle. The sampler can produce a constant volume of water per tidal cycle over a tidal range of 2-4 m. The complete sampler was tested in the Savannah River estuary in an area protected from large waves. It was hung from a piling and weighted on the bottom with 23 kg of lead to prevent excessive sway due to the fast tidal currents (up to 2 knots) in the estuary. It could have been rigidly attached, but it was easier to hang it. The sampler was left for 22 days (56 tidal cycles); the tidal range during this period was 1.8-3 m. The authors collected 980 cc of water during the 56 tidal cycles (average, 21 cc per tidal cycle). This is within the limit of 24 cc set by the sample chamber. (Humphreys-ISWS)
W80-06766

POTENTIOMETRIC SURFACE MAP OF THE FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, MAY 1979,
Geological Survey, Orlando, FL. Water Resources Div.
C. P. Laughlin, E. C. Hayes, and G. R. Shiner.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $3.50 in paper copy, $.50 in microfiche. Geological Survey Open-File Report 80-69, 1980. 1 Sheet.

Descriptors: *Maps, *Aquifers, *Groundwater, *Florida, Potable water, Water level fluctuations, Water wells, Hydrogeology, *Floridan aquifer, *Potentiometric level, Water table.

This map presents the potentiometric surface of the Floridan aquifer in the St. Johns River Water Management District and vicinity for May 1979. The Floridan aquifer is the principal source of potable water in the area. Water-level measurements were made on approximately 1200 wells and on several springs. The potentiometric surface is shown by 5-foot contour intervals except in the Fernandina Beach area where 20-foot intervals are used to show a deep cone of depression. This is the fourth map of a series covering the entire St. Johns River Water Management District and vicinity. Two maps cover the low water-level period in May and two show the high-water period in September. The potentiometric surface ranged from 125 feet above the National Vertical Datum of 1929 (NGVD) in Polk County to 120 feet below NGVD in Nassau County. (USGS)
W80-06785

7C. Evaluation, Processing and Publication

A SURVEY OF HELIUM IN GROUNDWATER IN PARTS OF SABARMATI BASIN IN GUJARAT STATE AND IN THE JAISALMER DISTRICT, RAJASTHAN,
Physical Research Lab., Ahmedabad (India).
P. S. Datta, S. K. Gupta, A. Jayasurya, V. N. Nijampurkar, and P. Sharma.
Hydrological Sciences Bulletin, Vol 25, No 2, p 183-193, June 1980. 5 Fig, 1 Tab, 14 Ref.

Descriptors: *Groundwater, *Water quality, *On-site investigations, *Helium, Aquifers, Foreign research, Foreign countries, Data collections, Surveys, Water sampling, Water wells, Analysis, Water analysis, *India.

The helium concentrations were measured in the groundwaters of the Sabarmati basin, Gujarat, and the Jaisalmer district, Rajasthan. The observed helium concentrations show localized anomalies. The magnitude of the excess helium was shown to be approximately inversely proportional to the square of the thickness of the sedimentary strata between the sampled aquifer and the Basement Trap surface in the Sabarmati basin. It was shown that the high helium concentration bears no relationship to the radio-carbon age of groundwater. It is believed that the helium anomalies arise due to the preferential degassing of the basaltic Basement along the fault zones because of the increased permeability and the opening of a larger thickness for degassing. Alternatively, it is possible that the observed anomalies are due to the degassing of mantle helium diffusing upwards along the zones of weakness (deep-seated Basement faults) in the crust. It should be possible to decide between these alternatives when data on isotopic ratios become available. Noting the ease with which total helium in groundwater samples are measured by using an ion pump with a quartz diaphragm, the authors suggested that a preliminary water helium survey be undertaken before the use of other rare gas isotopes for groundwater dating. (Humphreys-ISWS)
W80-06484

WATER RESOURCES DATA FOR VIRGINIA, WATER YEAR 1979.
Geological Survey, Richmond, VA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-220254, Price codes: A21 in paper copy, A01 in microfiche. Geological Survey Water-Data Report VA-79-1, July 1980. 463 p, 4 Fig, 1 Tab.

Descriptors: *Virginia, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water resources data for the 1979 water year for Virginia consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. This volume contains records for water discharge at 200 gaging stations, stage only at 1 gaging station, stage and contents at 9 lakes and reservoirs, water quality at 54 gaging stations and 38 wells, and water levels at 62 observation wells. Also included are data for 64 crest-stage partial-record stations. Locations of these sites are shown on maps. Additional water data were collected at various sites not involved in the systematic data-collection program. Discharge measurements and water-quality analyses were made at 97 coal-monitoring partial-record stations. Miscellaneous data were collected at 220 measuring sites and 64 water-quality sampling sites. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Virginia. (USGS)
W80-06510

WATER RESOURCES DATA FOR INDIANA, WATER YEAR 1979.
Geological Survey, Indianapolis, IN. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-224223, Price codes: A19 in paper copy, A01 in microfiche. Geological Survey Water-Data Report IN-79-1, June 1980. 419 p, 4 Fig, 3 Tab.

Descriptors: *Indiana, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water resources data for the 1979 water year for Indiana consists of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels in wells. This report contains discharge records for 186 gaging stations, stage and contents for 13 lakes and reservoirs, water quality for 65 gaging stations, and water levels for 74 observation wells. Also included are 98 crest-stage partial-record stations and 82 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Indiana. (USGS)
W80-06511

INDEX TO ACTIVE HYDROLOGIC DATA COLLECTION SITES IN FLORIDA, 1978-79,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. D. Simmons.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $50.25 in paper copy, $3.50 in microfiche. Geological Survey open-file report 80-220, 1980. 380 p, 2 Fig, 2 Ref.

Descriptors: *Indexing, *Hydrologic data, *Data collections, *Sites, *Florida, Gaging stations, Water quality, Surface waters, Groundwater, Water wells, Networks.

There are about 5,000 active data-collection sites in Florida operated by the U.S. Geological Survey in cooperation with State, local and Federal agencies. This index shows the location of each site, the cooperator(s) supporting the data-collection activities, the type and frequency of the data collected, and the U.S. Geological Survey office responsible for collecting and processing the data. (USGS)
W80-06512

HYDROGEOLOGIC DATA FOR THE MISSISSIPPI EMBAYMENT OF SOUTHEASTERN MISSOURI,
Geological Survey, Rolla, MO. Water Resources Div.
R. R. Luckey, and D. L. Fuller.
Geological Survey open-file report 79-421, January 1980. 199 p, 8 Fig, 10 Tab, 14 Ref.

Descriptors: *Hydrologic data, *Gulf Coastal Plain, *Missouri, *Water resources development, *Irrigation, Alluvial aquifers, Groundwater, Irrigation wells, Water levels, Data collections, Evaluation, Potential water supply, *Mississippi embayment, *Southeastern Missouri.

The Mississippi embayment of southeastern Missouri is a 4,000-square-mile agricultural area that is presently (1979) undergoing rapid development for irrigation. In July 1974, a project was initiated to evaluate the water resources of the area, determine the extent of irrigation, and to assess the future potential for irrigation supplies. This report provides well drillers, well owners, water users, and potential irrigators with the basic hydrologic data collected during the project. The 10 tables and eight figures show the location of irrigation wells, water-level networks to monitor ground-water and surface-water conditions, a pumpage network to estimate amounts of water used for irrigation, geologic data, municipal-well data, and water-quality data for selected wells. (USGS)
W80-06525

SURFICIAL GEOLOGY OF PART OF ELLISBURG QUADRANGLE, OSWEGO COUNTY, NEW YORK,

Geological Survey, Albany, NY. Water Resources Div.
T. S. Miller.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $1.75 in paper copy, $0.50 in microfiche. Geological open-file report 80-9 (WRI), 1980. 1 Sheet.

Descriptors: *Geology, *Glacial aquifers, *Groundwater potential, *Natural resources, *New York, Water wells, Water yield, Maps, Oswego County(NY).

The location and extent of eight kinds of surficial deposits in Ellisburg quadrangle Oswego County, NY, are mapped on a 7.5-minute U.S. Geological Survey topographic map. The map was compiled to indicate the lithology and potential for groundwater development at any specific location. (USGS)
W80-06529

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN MONTANA, OCTOBER 1979 THROUGH SEPTEMBER 1980.
U.S. Geological Survey, Helena, MT. Water Resources Div.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $6.25 in paper copy, $3.50 in microfiche. Geological Survey open-file report 80-222, March 1980. 45 p, 3 Fig, 2 Tab.

Descriptors: *Data collections, *Sites, *Hydrologic data, *Projects, *Montana, Water quality, Surface waters, Groundwater, Available water.

This report describes water-resources investigations of the U.S. Geological Survey in Montana, October 1979 through September 1980. Programs consist of (1) collecting hydrologic data on a continuing basis, (2) conducting water-resources appraisals of surface and ground water, (3) conducting supportive research in hydrology and related fields, (4) disseminating water data and results of investigations to the public, (5) coordinating acquisition of water data by Federal agencies, and (6) providing technical assistance in hydrologic fields to other government agencies. (USGS)
W80-06579

GENERAL STUDY OF THE MODIFIED EINSTEIN METHOD OF COMPUTING TOTAL SEDIMENT DISCHARGE,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2J.
W80-06593

STREAMFLOW STATISTICAL SUMMARIES FOR COLORADO STREAMS THROUGH SEPTEMBER 30, 1975, VOLUME 1: MISSOURI RIVER, ARKANSAS RIVER, AND RIO GRANDE BASINS,
Geological Survey, Lakewood, CO. Water Resources Div.
H. E. Petsch, Jr.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $67.25 in paper copy, $3.50 in microfiche. Geological Survey open-file report 79-681, May 1979. 515 p, 3 Fig, 2 Tab, 23 Ref.

Descriptors: *Hydrologic data, *Streamflow, *Streams, *Colorado, *Gaging stations, Surface waters, Flow duration, Discharge(Water), High flow, Low flow, Flow characteristics, Statistics, Annual, Monthly, Data collections, *Missouri River basin, *Arkansas River basin, *Rio Grande basin.

Statistical summaries of daily streamflow data for 246 stations east of the Continental Divide in Colorado and adjacent States are presented in this report. Duration tables, high-flow sequence tables, and low-flow sequence tables provide information about daily mean discharge. The mean, variance, standard deviation, skewness, and coefficient of variation are provided for monthly and annual flows. Percentages of average flow are provided for monthly flows and first-order serial-correlation coefficients are provided for annual flows. The text explains the nature and derivation of the data and illustrates applications of the tabulated information by examples. The data may be used by agencies and individuals engaged in water studies. (USGS)
W80-06596

WESTMINSTER QUADRANGLE: GEOLOGY, HYDROLOGY, AND MINERAL RESOURCES,
Geological Survey, Towson, MD. Water Resources Div.
E. G. Otton.
Maryland Geological Survey Quadrangle Atlas No 9, 1980. 5 Maps, 12 Ref.

Descriptors: *Maps, *Hydrogeology, *Groundwater, *Water table, *Groundwater availability, Maryland, Water supply, Land use, Planning, Water wells, Springs, Sites, Water yield, Waste water disposal, Septic tanks, Water pollution control, *Carroll County(MD), *Westminster quadrangle.

This series of map reports for the Westminster 7.5-minute quadrangle in Carroll County, MD, is designed to aid county, State, and Federal officials and engineers, planners, land developers, and the public in the prudent use of the water and land resources. The four maps and texts show the location of wells and springs; the approximate depth to the water table; the availability of ground water; and the constraints on the location of underground domestic sewage disposal systems. (USGS)
W80-06597

WINFIELD QUADRANGLE: GEOLOGY, HYDROLOGY, AND MINERAL RESOURCES,
Geological Survey, Towson, MD. Water Resources Div.
E. G. Otton.
Maryland Geological Survey Quadrangle Atlas No 10, 1980. 5 Maps, 13 Ref.

Descriptors: *Maps, *Hydrogeology, *Groundwater, *Water table, *Groundwater availability, Maryland, Water supply, Land use, Planning, Water wells, Springs, Sites, Water yield, Waste water disposal, Septic tanks, Water pollution control, *Carroll County(MD), *Winfield quadrangle.

This series of map reports for the Winfield 7.5-minute quadrangle in Carroll County, MD, is directed toward aiding county, State, and Federal officials, as well as engineers, planners, and the general public in the wise use of the water and land resources. The four maps show the location of wells and springs, the approximate depth to the water table, the availability of ground water, and constraints on the siting of underground domestic sewage disposal systems. (USGS)
W80-06598

NEW WINDSOR QUADRANGLE, MARYLAND: GEOLOGY, HYDROLOGY, AND MINERAL RESOURCES,
Geological Survey, Towson, MD. Water Resources Div.
E. G. Otton.
Maryland Geological Survey Quadrangle Atlas No 11, 1980. 5 Maps, 14 Ref.

Descriptors: *Maps, *Hydrogeology, *Groundwater, *Water table, *Groundwater availability, Maryland, Water supply, Land use, Planning, Water wells, Springs, Sites, Water yield, Waste water disposal, Septic tanks, Water pollution control, *Carroll County(MD), *New Windsor quadrangle(MD).

This series of map atlases for the New Windsor quadrangle in Carroll County, MD, is designed to aid county, State, and Federal officials, engineers, land developers, and the general public in the wise use of the water and land resources. The maps and associated text show the location of several hundred wells and a few springs and test borings, the approximate depth to the water table, the availability of groundwater supplies, and geohydrologic conditions pertaining to shallow underground disposal of domestic sewage. (USGS)
W80-06599

ASSESSING FLUID FLOW MEASUREMENTS,
Exxon Research & Engineering Co., Florham Park, NJ.
N. P. Cheremisinoff.
Water & Sewage Works, Vol 127, No 7, p 44-45, 48, 53, 62, July 1980. 6 Fig, 1 Tab, 4 Ref.

Descriptors: *Flow measurement, *Instrumentation, *Flowmeters, *Flow rates, Venturi meters, Orifice flow, Pitot tubes, Anemometers, Water measurement, Equations, Pressure, Flow control.

Operating principles of flow-measuring instruments are reviewed under the classes of differential pressure meters (venturi meter, Dall tube, orifice meter, flow nozzle, pitot tube), positive displacement meters (reciprocating piston, rotary-piston, rotary vane, mutating disk), mechanical flow meters (rotameter, turbine meter), magnetic flow meters, ultrasonic flow measurement devices (Doppler flow meter), and mass-flow transducer systems (anemometer). Differential-pressure, mechanical flow, magnetic flow, and Doppler flow devices are diagrammed. Venturi and Dall meters provide measurements to within + or - 0.5%, and are usually self-cleaning. Flange-mounted orifice plates can be inserted and removed from a line without disturbing existing piping/differential-pressure connections. Flow equations for orifice plates are applicable to flow nozzles (discharge coefficient of 0.98 can be used). Pitot tubes give only point measurements of the velocity head. Positive-deplacement flow meters are used where high accuracy of flow is needed under steady flow conditions. Magnetic flow meters are advantageous for low-pressure applications. Mass-flow transducers are not recommended for fluids that are viscous or contain solids, and are affected by fluid-temperature variations. (Zielinski-IPA)
W80-06643

MAPS SHOWING HYDROLOGIC CONDITIONS IN THE SAN FRANCISCO RIVER AREA, GREENLEE COUNTY, ARIZONA, 1978--A RECONNAISSANCE STUDY,
Geological Survey, Tuscon, AZ. Water Resources Div.
L. J. Mann.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $7.00 in paper copy, $1.00 in microfiche. Geological Survey Open-File Report 80-441, April 1980. 2 Sheets, 4 Fig, 8 Ref.

Descriptors: *Maps, *Groundwater, *Surface waters, *Water quality, *Arizona, Water utilization, Irrigation, Water wells, Water levels, Streamflow, Low flow, Flow characteristics, Dissolved solids, Fluorides, Hydrographs, *San Francisco River area(AZ), *Greenlee County(AZ).

The San Francisco River area includes about 950 square miles in Greenlee County in east-central Arizona. Water-resources development has been slight compared with that in many areas in Arizona. In 1978 about 500 acre-feet of water was diverted for irrigation from the San Francisco and Blue Rivers, and about 550 acre-feet of ground water was withdrawn from wells for municipal use at Clifton. Surface water and ground water generally contained less than 500 milligrams per liter of dissolved solids; however, in the San Francisco River the dissolved-solids concentration increased from 263 to 885 milligrams per liter as the water moved downstream. The increase in dissolved solids was caused by inflow from springs near Clifton, one of which contained 11,700 milligrams per liter of dissolved solids. Information shown on the maps includes altitude of the water level, depth to water, well depth, streamflow characteristics of the San Francisco and Blue Rivers, and dissolved-solids and fluoride concentrations. (USGS)
W80-06796

ANNUAL SUMMARY OF GROUND-WATER CONDITIONS IN ARIZONA, SPRING 1978 TO SPRING 1979.
Geological Survey, Tuscon, AZ. Water Resources Div.

For primary bibliographic entry see Field 4B.
W80-06797

WATER RESOURCES DATA FOR KANSAS, WATER YEAR 1979--VOLUME 1. MISSOURI RIVER BASIN.
Geological Survey, Lawrence, KS. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-195803, Price codes: A16 in paper copy, A01 in microfiche. Geological Survey Water-Data Report KS-79-1, April 1980. 372 p, 8 Fig, 4 Tab.

Descriptors: *Kansas, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, *Missouri River basin(KS).

Water resources data for the 1979 water year for Kansas consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality in wells. This report contains discharge records for 83 gaging stations, stage and contents for 14 lakes and reservoirs, water quality for 46 gaging stations and 2 lakes, and water levels for about 236 observation wells and water quality for about 265 wells. Also included are data for 62 crest-stage partial-record stations. All data in this report represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Kansas. (Kosco-USGS)
W80-06798

WATER RESOURCES DATA FOR PENNSYLVANIA, WATER YEAR 1979--VOLUME 2. SUSQUEHANNA AND POTOMAC RIVER BASINS.
Geological Survey, Harrisburg, PA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-198864, Price codes: A18 in paper copy, A01 in microfiche. Geological Survey Water-Data Report PA-79-2, April 1980. 403 p, 8 Fig, 1 Tab.

Descriptors: *Pennsylvania, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, *Susquehanna and Potomas River basins(PA).

Water resources data for the 1979 water year for Pennsylvainia consist of records of discharge and water quality of streams, contents of lakes, and reservoirs, and water levels of ground-water wells. This volume contains records for water discharge at 105 stations, contents at 10 lakes and reservoirs, water quality at 27 gaging stations, and water levels at 40 observation wells. Also included are data for 20 crest-stage, 45 low-flow, and 130 water-quality partial-record stations. Locations of these sites are shown. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data together with the data in volumes 1 and 3 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Pennsylvania. (Kosco-USGS)
W80-06799

MAP OF INDIAN WELLS VALLEY, CALIFORNIA, SHOWING CHANGE IN WATER LEVEL, 1963-78, AND HYDROGRAPHS OF SELECTED WELLS,
Geological Survey, Laguna Niguel, CA. Water Resources Div.
Available from OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $1.75 in paper copy, $.50 in microfiche. Geological Survey open-file map 80-342, 1980. 1 sheet.

Descriptors: *Maps, *California, *Water levels, *Water level fluctuations, *Aquifiers, Groundwater, Water wells, Pumping, *Indian Wells Valley(CA), Hydrographs, Groundwater basins, Faults(Geologic), Topographic mapping.

The U.S. Geological Survey has released to the open file a map showing change in water level, 1963-78, and hydrographs of selected wells in Indian Wells Valley, Calif. (USGS)
W80-06803

SHORT STATISTICAL ANALYSIS OF TOTAL LOAD CONCENTRATION,
Punjab Agricultural Univ., Ludhiana (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W80-06824

A DATA MANAGEMENT SYSTEM FOR FINITE ELEMENT SEDIMENT TRANSPORT MODELS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab. Ha.
V. E. LaGarde, and S. B. Heltzel.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol.), Mississippi University, Oxford, May 19-23, 1980. p 6.35-6.46, 1980. 5 Fig, 1 Tab. Science and Education Administration, New Orleans, LA.

Descriptors: *Finite element analysis, *Data processing, Data storage and retrieval, *Sediment transport, Data collections, Data management.

The objectives of this paper were to describe the computer based Waterways Experiment Station Data Management System A (DMS) used for finite element method (FEM) model data preparation, and to illustrate the application of the DMS by reference to its use in the sediment transport studies. The DMS consists of a series of computer-aided data management procedures and provides a formal and consistent method for raw data recovery, transformation to a grid coordinate system, quality control, accession, manipulation, analysis, and display. The DMS proved useful for handling a variety of spatially and temporally distributed data. (See also W80-06894) (Humphreys-ISWS)
W80-06923

RELIABLE A-POSTERIORI ESTIMATES AND ADAPTIVE PROCEDURES FOR SOLVING PARTIAL DIFFERENTIAL EQUATIONS,
Maryland Univ., College Park. Dept. of Mathematics.
I. Babuska.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 7.3-7.11, 1980. 3 Tab, 7 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Finite element analysis, *Mathematical models, *Mathematics, Analytical techniques, Mathematical studies, Analysis, Equations, Numerical analysis, Theoretical analysis.

The goal of scientific computations is a quantitative analysis of natural phenomena. This analysis has two essential parts; (1) the mathematical formulation of the problem, and (2) the numerical-approximate-solution of this mathematical problem. These two stages are closely related. The mathematical formulation is usually a simplified one, taking into consideration the solution phase in which a more complex formulation leads to more reliable results. The first part of this paper described some features of the finite element solver FEARS developed at the University of Maryland. In addition to the usual results, the model gives reliable error estimates and has an adaptive character. The second part of this work describes the adaptive selection of the mathematical model. (See also W80-06894) (Humphreys-ISWS)
W80-06925

INTERACTIVE FINITE ELEMENT MESH GENERATORS FOR FLOW SYSTEMS,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical and Environmental Engineering.
For primary bibliographic entry see Field 2E.
W80-06933

8. ENGINEERING WORKS

8A. Structures

CONFINED FLOW IN AQUIFER CONTAINING THIN LAYER,
Missouri Univ. Columbia, Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W80-06678

A SURVEY OF FREE BOUNDARY VALUE PROBLEMS IN THE THEORY OF FLUID FLOW THROUGH POROUS MEDIA: VARIATIONAL INEQUALITY APPROACH--PART I,
California Univ., Santa Barbara. Dept. of Mechanical and Environmental Engineering.
For primary bibliographic entry see Field 2F.
W80-06681

HYDROLOGIC DATA COLLECTED AT CLOSURE OF GAINESVILLE LOCK AND DAM, TOMBIGBEE RIVER NEAR GAINESVILLE, ALABAMA,
Geological Survey, Tuscaloosa, AL. Water Resources Div.
For primary bibliographic entry see Field 4A.
W80-06793

ON THE ACCURACY OF FINITE ELEMENT SOLUTIONS OF PROBLEMS WITH TRACTION BOUNDARY CONDITIONS,
Battelle Columbus Lab., OH.
H. C. Rhee, and S. N. Atluri.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 7.79-7.88, 1980. 5 Fig, 6 Ref. Science and Education Administration, New Orleans, LA. NSF-ENG-74-21346.

Descriptors: *Finite element analysis, *Mathematical models, *Stress analysis, *Boundary processes, Model studies, Analytical techniques, Analysis, Mathematical studies, Equations, Numerical analysis, Strength of materials, Boundaries(Surfaces), Interfaces, Hybrid models.

The nature of the implicit enforcement of the natural boundary conditions of a problem through a variational formulation was investigated. Systematic methods to enforce natural boundary conditions explicitly to improve the accuracy of solutions were developed for two finite element models. Several example problems with natural boundary (traction-free) conditions, that have varying degrees of importance to the structural responses of the appropriate system were considered. Through numerical analyses, it was found that the more important the traction free boundaries are to the response characteristics of the system, the more improvement of the accuracy of solutions is obtained by an explicit enforcement of the natural boundary conditions. (See also W80-06894) (Humphreys-ISWS)
W80-06931

ON THE CONSTRUCTION OF COMPATIBLE ELEMENTS WITH THE USE OF GENERALIZED PARAMETERS,
Kansas State Univ., Manhattan. Dept. of Civil Engineering.
K. K. Hu, P. G. Kirmser, S. E. Swartz, and J. M. Huang.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 7.89-7.98, 1980. 2 Fig, 4 Ref, 1 Append. Science and Education Administration, New Orleans, LA. NSF ENG 78-07829.

Descriptors: *Finite element analysis, *Mathematical models, *Stress analysis, *Hydraulic structures, Model studies, Analytical techniques, Analysis, Methodology, Mathematical studies, Strength of materials, Boundaries(Surfaces).

The importance of the design and construction of hydraulic structures in the effective use of water resources is well known. Modern methods of stress and deformation analysis depend heavily on the use of finite element methods and mechanized computations. This paper presented methods for constructing generalized finite elements which use functions and derivatives at nodal points as parameters. The finite elements constructed include the use of both functions and derivatives as generalized parameters and are arranged to provide compatibility, either exterior or interior. For triangular elastic bodies (which seldom occur in practice), the solutions obtained are exact for interior compatible elements in which the boundary forces belong to the sub-space of the interpolating functions used. The construction of interior compatible elements is more expensive than that of exterior compatible ones. However, the use of carefully chosen interpolating functions, such as those presented for the second form of interior compatible triangular elements, can reduce costs substantially. A problem that remains is one of constructing suitable sets of interpolating functions so that new families of finite elements can be formed which are both exterior and interior compatible. (See also W80-06894) (Humphreys-ISWS)
W80-06932

8B. Hydraulics

METHOD FOR PERFORATING WATER WELL PIPE CASINGS,
E. M. Jannsen.
U.S. Patent No 4,182,418, 5 p, 8 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 990, No 2, p 532, January 8, 1980.

Descriptors: *Patents, *Water wells, *Well casings, Water supply, Water supply development, Equipment, Well casing perforation.

Development of a well means the removal of the mud, sand and other debris from within the well casing and stabilization of water flow through such removal. It is the object of this invention to produce a tool which is capable of perforating water well casing and subsequently develop the well without the addition of further tooling and without removal of the tool and drill string from the well. A tool for perforating water well pipe casing is designed for use with air rotary water well drilling apparatus. The tool includes a slidable casing perforator wheel actuated by a pneumatic cylinder carried within the tool. The casing is perforated and subsequent development of the well is carried out while the tool is in place. (Sinha - OEIS)
W80-06460

ANALYSES OF WATER, CORE MATERIAL, AND ELUTRIATE SAMPLES COLLECTED NEAR SICILY ISLAND, LOUISIANA (SICILY ISLAND AREA LEVEE PROJECT),
Geological Survey, Baton Rouge, LA. Water Resources Div.
D. K. Demcheck, and A. J. Dupuy.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $2.50 in paper copy, $3.50 in microfiche. Geological Survey open-file report 80-434, April 1980. 17 p, 7 Fig, 4 Tab, 13 Ref.

Descriptors: *Water analysis, *Levees, *Flood control, *Louisiana, *Core drilling, Sampling, Construction, Baseline studies, Data collections, Sediments, Metals, Pesticides, Chemical analysis, Flood frequency, Backwater, *Sicily Island(LA), Elutriate analysis.

Samples consisting of composited core material were collected from five areas by the U.S. Army Corps of Engineers and analyzed by the U.S. Geological Survey to provide data on the impact of proposed channel excavation and levee construction in the Sicily Island area, Louisiana. Samples of receiving water from the five areas, selected to represent the water that will contact the proposed dredged material of the levee fill material, also were collected. Chemical and physical analyses were performed on samples of core material and native water and on elutriate samples of specific core material-receiving water mixtures. The results of these analyses are presented without interpretation. (USGS)
W80-06517

OUTLET WORKS FOR CERRILLOS DAM, CERRILLOS RIVER, AND PORTUGUES DAM, PORTUGUES RIVER, PUERTO RICO; HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
J. F. George.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A068214, Price codes: A04 in paper copy, A01 in microfiche. Technical Report HL-79-6, March 1979. 52 p, 13 Ph, 18 Pl.

Descriptors: *Outlet works, *Hydraulic models, *Dams, Settling basins, Discharge(Water), Prototype tests, Puerto Rico, *Stilling basins, *Cerrillos Dam(PR), *Portugues Dam(PR).

Tests were conducted on a 1:24-scale model of the outlet works for the Cerrillos and Portugues Dams located in Puerto Rico. Purpose of the model investigation was to determine the performance of the stilling basins for the full range of discharges with minimum head pool and the optimum riprap protection plan for the exit channel. The model reproduced a schematic of the intake tower, conduit transition, 60 percent of the conduit length, the stilling basins, and exit channel. The original design stilling basin (type 1) for the Cerrillos outlet works performed satisfactorily for low discharges of 500 cfs and less, and for the higher range of discharges between 1500 and 2500 cfs (design discharge). However, with the intermediate discharge of 1000 cfs, eddy conditions developed. Recommended modifications (type 14 stilling basin) incorporated into the original design included extending the invert immediately downstream from the outlet portal horizontally for 10 ft, raising the basin apron, relocating and reducing the size of the baffle blocks, and terminating the basin with a sloping end sill. These modifications produced satisfactory flow conditions for the full range of discharges. The optimum riprap protection plan was developed for the exit channel. (WES)
W80-06538

NAVIGATION CONDITIONS AT JOHN H. OVERTON LOCK AND DAM, RED RIVER; HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
L. J. Shows, and J. J. Franco.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A068212, Price codes: A05 in paper copy, A01 in microfiche. Technical Report HL-79-3, March 1979. 83 p, 9 Tab, 11 Ph, 24 Pl.

Descriptors: *Locks, *Dams, *Navigation, Model studies, Prototype tests, Navigation conditions, *John H. Overton Dam(LA), *Red River(LA).

A semifixed-bed model reproducing about 3.7 miles of the Red River channel and adjacent overbank areas to an undistorted scale of 1:100 was used to provide some general information on navigation conditions with the proposed design and to develop such modifications as might be required to eliminate conditions that would adversely affect navigation using the John H. Overton Lock. Results revealed: (1) Satisfactory navigation conditions in the upper lock approach could be developed with modification of the excavation along the left bank of the approach channel and extending the length of the upper guard wall. (2) The length of the overflow weir and excavation along the right bank of the cutoff channel could be reduced without affecting navigation conditions in the lock approaches or flow through the dam. (3) Satisfactory navigation conditions could be developed in the lower lock approach with either a floating guide wall (land side) or a guard wall (river side). Conditions for two-way traffic would be better with the guide wall. (4) The differences in the water-surface elevations across the dam with plans tested would tend to be small. (WES)
W80-06546

MODEL STUDY OF HARRY S. TRUMAN SPILLWAY, OSAGE RIVER, MISSOURI,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
G. A. Pickering, and D. B. Murray.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A081 818, Price codes: A04 in paper copy, A01 in microfiche. Technical Report HL-79-20, November 1979. 51 p, 1 Tab, 20 Pho, 17 Pl.

Descriptors: *Aeration, *Spillways, *Supersaturation, *Gases, Hydraulic models, *Fishkill, Model studies, Water pollution control, Dams, Osage River(MO), *Harry S. Truman Dam(MO).

A fish kill was experienced during the spring of 1978 downstream of the partially completed spillway of the Harry S. Truman Dam which is located on the Osage River in Benton County, Mo. The fish kill was attributed to excessive gas supersaturation in the water downstream of the dam. Flow passing the partially completed spillway became serated and then plunged to the bottom of the stilling basin where high pressure caused by deep tailwater forced the air into solution. A 1:30-scale section model was used to develop a design to prevent gas supersaturation downstream of the spillway for both the partially and fully completed spillway. Immediate relief from the problem was accomplished by removing a 6-ft-deep by 30-ft-long portion of the existing downstream spillway invert. Curves showing tailwater elevations where flow either will or will not plunge into the stilling basin for various discharges and stages of spillway completion were obtained. A flip lip was developed for the lower portion of the completed spillway to divert lower flows out across the tailwater surface. Higher flows with thicker nappes will pass over this lip into the stilling basin for effective energy dissipation. (WES)
W80-06547

NUMERICAL ANALYSIS OF TIDAL CIRCULATION FOR LONG BEACH OUTER HARBOR PROPOSED LANDFILL,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 2L.
W80-06549

A STUDY OF SUBMERGED BREAKWATERS,
Singapore Univ. Dept. of Civil Engineering.
M. H. A. Khader, and S. P. Rai.
Journal of Hydraulic Research, Vol 18, No 2, p 113-121, 1980. 9 Fig, 1 Tab, 11 Ref.

Descriptors: *Breakwaters, *Hydraulic structures, *Model studies, *Barriers, Hydraulic models, Laboratory tests, Waves(Water), Testing procedures, Coasts, Hydraulics, Energy, Energy dissipation, Submerged breakwaters, Wave characteristics.

The results of an experimental investigation on the damping action of impermeable, submerged breakwater of various shapes were presented and discussed. The effectiveness of the breakwater in damping the incident wave energy was measured in terms of coefficient of transmission. The results were plotted in relevant nondimensional parameters and comparisons were made with well-known semi-empirical theories and other available experimental results whenever applicable. The results showed that the damping action of waves increases with the height of the barrier, and rectangular-shaped barriers were found to be the best among the various shapes tested. In determining the effect of a single parameter on the wave damping it was observed that waves with relatively high steepness are damped more effectively than waves having low steepness; waves in low relative depths have smaller transmission coefficients than in high

relative depths; a relatively wider barrier has a better damping action than a narrower one. (Humphreys-ISWS)
W80-06606

VORTICES AT VERTICALLY INVERTED INTAKE,
Hydraulics Research Station, Wallingford (England).
H. O. Anwar, and M. B. Amphlett.
Journal of Hydraulic Research, Vol 18, No 2, p 123-134, 1980. 12 Fig, 16 Ref.

Descriptors: *Vortices, *Model studies, *Intakes, *Hydraulic structures, Flow, Hydraulic models, Laboratory tests, Conduits, Hydraulics, Data collections, Flow characteristics, Air entrainment, Analytical techniques, Analysis, Circulation, Discharge(Water), Discharge coefficients, Surface tension, Viscosity, Vertical intakes, Submerged intakes.

A laboratory study was undertaken to measure variables responsible for the formation of air-entraining vortices with a slender air core extending from the free surface to the entry of a vertically inverted intake. The measured data indicate unique relations between radial and vertical scale for air-entraining vortices of the above description. From the measured data nondimensional parameters governing the formation of such vortices were determined. The results of this approach gave universal curves which are independent of the intake geometry and the intake diameter. On this basis the measured data for horizontal intake, given in a previous paper, were re-evaluated and the results for both types of intake were compared. It was found that the effect of the kinematic viscosity and the surface tension on the measured values become negligibly important when nondimensional parameters describing these effects are larger than 30,000--a value which is independent of the intake geometry and the intake diameter, but not on the type of intake. The bellmouth entry did not improve critical submergence heads for both types of intake as compared to those obtained for the simple pipe intake, but it did improve entry flow conditions. (See also W78-12160) (Humphreys-ISWS)
W80-06607

TURBULENCE IN HELICALLY CORRUGATED PIPE FLOW,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
E. Silberman.
Journal of the Engineering Mechanics Division, American Society of Civil Engineers, Vol 106, No EM4, Proceedings Paper 15633, p 699-717, August 1980. 15 Fig, 2 Tab, 10 Ref, 2 Append. NSF GK-33817.

Descriptors: *Pipe flow, *Turbulent flow, *Laboratory tests, *Flow, Closed conduit flow, Turbulence, Rotational flow, Flow resistance, Data collections, Flow characteristics, Analytical techniques, Velocity, Spatial distribution, Corrugated pipe.

Results were reported of experimental measurements of friction factor, mean and turbulent velocities, and Reynolds stresses in fully developed flow through a helically corrugated pipe. Helical corrugations induce a strong rotational component in the mean flow near the wall but this decreases rapidly toward the pipe axis. Turbulence intensities and axial shear are generally smaller in this flow than in nonrotation pipe flow, and the redduction is attributed to rotation. Reynolds stress measurements extrapolated to the wall are in agreement with pressure drop measurements. Both show that pipe friction factor is less in helically corrugated pipe than in normally corrugated pipe, other factors being the same. The axial component of the mean flow is well fitted by the two-dimensional semilogarithmic law-of-the-wall for rough pipes. It was also fitted by the defect law but the numerical parameters of the latter behave as in an adverse pressure gradient boundary layer, indicating less shear stress than in nonrotating pipe flows. This is consistent with reduced friction factor. (Humphreys-ISWS)
W80-06755

TURBULENCE MEASUREMENTS IN SIMULATED TIDAL FLOW,
Hydraulics Research Station, Wallingford (England).
H. O. Anwar, and R. Atkins.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY8, Proceedings Paper 15609, p 1273-1289, August 1980. 11 Fig, 19 Ref, 3 Append.

Descriptors: *Turbulent flow, *Unsteady flow, *Model studies, *Laboratory tests, Hydraulic models, Flumes, Turbulence, Energy, Velocity, Stress, Shear stress, Beds, Tides, Surface drainage, Hydraulics, Coastal waters, Tidal flow.

Field measurements of tidal flow have shown that there is an increase in turbulent parameters (turbulent intensity, Reynolds stress, coefficient of turbulent diffusivity, and the rate of sediment transport) when the flow is decelerating as compared with when it is accelerating. A series of experiments were conducted to study the effect of unsteady flow on turbulence characteristics. The flow in a long flume was accelerated and then decelerated for the same periods of time. Instantaneous velocity components in three directions, water surface slope, and shear stress at bed were measured. From measured data mean velocity profiles, temporal and spatial Reynolds stress profiles, and energy spectra were determined. The results were compared, wherever possible, with those obtained from field measurements. (Sims-ISWS)
W80-06817

NEAR FIELD MIXING OF STAGED DIFFUSER,
Delaware Univ., Newark. Dept. of Civil Engineering.
J. H. W. Lee.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY8, Proceedings Paper 15654, p 1309-1324, August 1980. 8 Fig, 2 Tab, 18 Ref, 4 Append.

Descriptors: *Mixing, *Discharge(Water), *Heated water, *Model studies, Mathematical models, Distribution patterns, Flow, Subsurface flow, Diffusion, Entrainment, Momentum transfer, Temperature, Heat, Hydraulics, Environmental engineering, Diffusers, Subsurface diffusers, Staged diffusers, Near field mixing.

A two-dimensional theory that models a staged diffuser as a continuous line source of mass, heat, and momentum was formulated and solved. The model assumed that the major dilution mechanism is due to side entrainment and involved the use of only an entrainment coefficient obtained from classical jet literature. Constant induced velocities and excess temperatures were predicted. Solution properties were compared with that of a turbulent free jet, and the theoretical predictions were validated against existing experimental data. In the case of a diffuser discharging on a sloping bottom, the theory also suggests an optimal distribution of the momentum and heat load to take advantage of the increasing depth in the offshore direction. (Sims-ISWS)
W80-06819

TRANSIENT PROPAGATION IN SLURRIES WITH HOLD-UP,
City Univ., London (England).
A. R. D. Thorley.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY8, Proceedings Paper 15641, p 1353-1364, August 1980. 6 Fig, 2 Tab, 13 Ref, 3 Append.

Descriptors: *Hydraulic transportation, *Slurries, *Pipelines, *Model studies, Mathematical models, Surges, Water hammer, Pressure, Flow, Velocity, Materials, Density, Coals, Sands, Waves(Water), Wave velocity, Amplitude.

The relatively high flow velocities encountered in the hydraulic transport of solid-liquid mixtures aggravates the problems of pressure surge phenomena under fault conditions as well as during normal system load changes. The paper presented the basic theory for estimating surge amplitudes and wave speeds and extended previous work by investigating the influence of hold-up. It was concluded that hold-up reduces the amplitude of surge pressures and that further studies are required to establish a suitable relationship between the hold-up ratio and both solids concentration and the density ratio. Nevertheless, favorable agreement was found between the limited experimental data available and the theoretical model. (Sims-ISWS)
W80-06822

WIND SETUP EFFECTS IN LARGE OPEN CHANNELS,
California Univ., Davis. Dept. of Land, Air, and Water Resources.
J. J. DeVries, and J. Amorocho.
Journal of the Waterway, Port, Coastal and Ocean Division, American Society of Civil Engineers, Vol 106, No WW3, Proceedings Paper 15608, p 319-334, August 1980. 8 Fig, 1 Tab, 17 Ref, 3 Append.

Descriptors: *Open channel flow, *Winds, *Effects, *Model studies, Mathematical models, Flow, On-site investigations, Waves(Water), Wind tides, Surges, Wind pressure, Channels, Aqueducts, Canals, Water levels, Fluctuations, Water level fluctuations, Equations, Hydraulics, *California Aqueduct.

Measurements in a large conveyance canal in California permitted the evaluation of the water surface superelevation ('setup' due to wind shear in the axial direction of the channel). Through the use of a general equation for the wind shear proposed by the writers, it was shown that the wind setup can be computed closely for various flow conditions, including unsteady states. It was also shown that the wind shear in open channels obeys the same general laws applicable to seaways. (Sims-ISWS)
W80-06830

LABORATORY GENERATED WAVES AND WAVE THEORIES,
Chicago Bridge and Iron Co., Plainfield, IL. Marine Research and Development.
S. K. Chakrabarti.
Journal of the Waterway, Port, Coastal and Ocean Division, American Society of Civil Engineers, Vol 106, No WW3, Proceedings Paper 15644, p 349-368, August 1980. 14 Fig, 1 Tab, 8 Ref, 2 Append.

Descriptors: *Waves(Water), Laboratory tests, Theoretical analysis, *Model studies, Mathematical models, Pressure, Hydraulics, Hydraulic models, Measurement, Data processing, Correlation analysis, Equations, *Design criteria, *Coastal structures, Wave tanks, Wave pressure, Kinematics, Solitons.

Tests were carried out in a wave tank to record the waves, the water pressures, and the horizontal and vertical water particle velocities. The water depth was such that the waves generated during the test cover the deep, intermediate, and shallow water ranges. In the intermediate and shallow water range the soliton effects were observed. In deep water, the Airy wave theory was found to describe the water particle kinematics adequately. Stokes' 3rd order wave theory was found to be valid for higher waves in intermediate water depths. Stream function theory was found to agree reasonably with the test data in general. Based on these comparisons, a region of validity of various wave theories was described and compared with other predicted regions in the literature. (Sims-ISWS)
W80-06832

FINITE ELEMENT COMPUTATION OF TURBULENT FLOWS,
California Univ., Davis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W80-06897

FEM SOLUTION OF THE NAVIER-STOKES EQUATIONS FOR VORTEX SHEDDING BEHIND A CYLINDER: EXPERIMENTS WITH THE FOUR-NODE ELEMENT,
California Univ., Livermore. Lawrence Livermore Lab.
P. M. Gresho, R. L. Lee, and C. D. Upson.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 4.48-4.65, 1980. 14 Fig, 1 Tab, 10 Ref. Science and Education Administration, New Orleans, LA. DOE W-7405-Eng-48.

Descriptors: *Finite element analysis, *Vortices, *Flow characteristics, *Model studies, Flow around objects, Mathematical models, Analytical techniques, Numerical analysis, Analysis, Drag, Vortex shedding, Cylinders, Navier-Stokes equations, Four-node element, Lift.

Results were compared from three variations on a simple 4-node element (bilinear velocity and piecewise constant pressure) with those from a higher order element (9-node biquadratic velocity and 4-node bilinear pressure) on the same problem and on the same grid. The three 'simple element' approximations are: (1) full quadrature (3x3 Gauss) using the consistent mass matrix (conventional Galerkin FEM), (2) full quadrature but employing the lumped mass approximation via the 'row sum' technique, and (3) one-point quadrature and lumped mass. Overall, the results were somewhat surprising and generally disappointing. The 4-node element failed to simulate correctly vortex shedding on the same grid for which the 9-node element was successful. Mass lumping the 4-node element causes serious phase speed errors and, for flows in which discrete waveforms (e.g., vortices) must be transported by the flow, will only be accurate on a very fine mesh, such as would be required by a typical second-order finite difference method. Even when mass lumping is invoked, the 9-node element is still quite accurate on a coarser mesh. One-point quadrature is a viable option for the 4-node element since it generates results not much different than those using full quadrature when mass lumping is employed for each. Overall, it appears to be less deleterious than mass lumping itself, at least for vortex shedding simulations. (See also W80-06894) (Humphreys-ISWS)
W80-06898

SOME REMARKS ON FINITE ELEMENT ANALYSIS OF VISCOUS FLOW EQUATIONS,
Texas Inst. of Computational Mechanics, Austin.
G. F. Carey.
In: Finite Elements in Water Resources, Vol 2; Preprints of the Third International Conference (2 Vol), MS Univ., Oxford, May 19-23, 1980. p 4.66-4.72, 1980. 15 Ref. Science and Education Administration, New Orleans, LA. NASA NSG 2338.

Descriptors: :Finite element analysis, *Viscous flow, *Mathematical models, Flow characteristics, Analytical techniques, Analysis, Approximation method, Velocity, Pressure, Navier-Stokes equations.

Variational formulations of viscous flow problems were brieflydescribed. By means of consistency conditions between the velocity and pressure approximations certain classes of elements may be shown to be suitable for restricted flow problems only while others are broadly applicable. Several such instances were summarized, and the physical implications of the conditions for viscous flow computation were discussed. These mathematical arguments both for the fnite element system and locally as a form of 'patch test' provided additional means for analyzing and understanding numerical methods for computing viscous flows. (See also W80-06894) (Humphreys-ISWS)
W80-06899

A CONFORMING FINITE ELEMENT FOR THE ANALYSIS OF VISCOUS INCOMPRESSIBLE FLUID FLOW,
Liege Univ. (Belgium). Aerospace Lab.
P. Beckers, and S. Idelsohn.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 4.73-4.81, 1980. 3 Fig, 6 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Finite element analysis, *Viscous flow, *Mathematical models, *Flow characteristics, Analytical techniques, Velocity, Flow, Analysis, Approximation method, Navier-Stokes equations.

The purpose of this paper was to present a family of finite elements based upon a mixed formulation. Its main particularity is that the imcompressibility condition is introduced by means of internal degrees of freedom and therefore the pressure continuity is not imposed between the elements. A solution technique based on quasi-Newton methods was also tested in fluid flow problems. A mixed finite element with internal degrees of freedom was tested for the solution of Navier-Stoke equations. The internal Lagrangian multipliers give a better representation of the incompressibility condition. An economical element with parabolic velocity field and only one supplementary internal degree of freedom was found and tested in this paper. Quasi-Newton techniques used for the non-linear solution seem to diverge for relatively small Reynolds number flows. (See also W80-06894) (Humphreys-ISWS)
W80-06900

A HYBRID FINITE ELEMENT MODEL APPLIED TO UNSTEADY FLOW PROBLEMS,
New Orleans Univ., LA. Dept. of Civil Engineering.
A. A. Hannoura.
In: Finite Elements in Water Resources, Volume 2; Preprints of the Third International Conference (2 Vol), Mississippi University, Oxford, May 19-23, 1980. p 4.82-4.91, 1980. 8 Fig, 12 Ref. Science and Education Administration, New Orleans, LA.

Descriptors: *Finite element analysis, *Flow, *Embankments, *Mathematical models, Waves(Water), Hydraulic structures, Porous media, Analytical techniques, Unsteady flow, Pores, Model studies, Pressure, Hydrostatic pressure, Hydraulic models, Internal waves, *Porous structures, Method of characteristics, Hybrid model.

This paper presented a hybrid finite element model which is applicable to a wide range of the two-dimensional unsteady free surface flow problems. The problem considered was the analysis of the internal flow due to wave interaction with a porous structure with an impervious core. The problem was formulated in two stages: (1) the development of the hyperbolic differential equations which were solved by the finite difference scheme and method of characteristics in order to compute the instantaneous water surface; (2) the introduction of the FEM to estimate representative values of pressure distribution correction factor, and the hydraulic conductivity of porous matrix. The combined finite element-method of characteristics model was shown to give good agreement with experimental results for short period waves. The capability of the combined model to predict transmission of long period waves can be improved by utilizing more general boundary conditions at the interface and to account for internal wave breaking. The available boundary conditions were obtained from short period waves. The hybrid model requires about twice the CPU time of a one-dimensional method of characteristics model, but only 40% of the time required for a complete finite element model. Furthermore, the hybrid model can treat non-homogeneous embankments with irregular boundaries; this is inconvenient with the normal method of characteristics model. The model provides a simple treatment of wave transmission in porous structures which should permit design engineers to improve the stability analysis of these structures. (See also W80-06894) (Humphreys-ISWS)
W80-06901

ON THE ACCURACY OF FINITE ELEMENT SOLUTIONS OF NAVIER-STOKES EQUATIONS USING A VELOCITY-PRESSURE FORMULATION,
Georgia Inst. of Tech., Atlanta. School of Nuclear Engineering.
For primary bibliographic entry see Field 2E.
W80-06902

8C. Hydraulic Machinery

PROTOTYPE GATE VIBRATION TESTS, BARKLEY DAM, CUMBERLAND RIVER, KENTUCKY,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
D. E. Hart, and J. E. Hite, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PBAD A071 572, Price codes: A03 in paper copy, A01 in microfiche. Technical Report HL-79-8, May 1979. 43 p, 3 Tab, 14 Pl, 11 Ref.

Descriptors: *Gates, *Spillway gates, *Dams, Vibrations, Prototypes, *Prototype tests, Evaluation, Design criteria, Engineering structures, *Gate vibration, *Barkley Dam(KY).

Presents data obtained during prototype tests concerned with the vibration of the 50- by 55-ft spillway tainter gates at Barkley Dam. The gates vibrate during flow passage in which the gate lip is submerged by high tailwater. Field tests were conducted on two of the gates during high tailwater. Three pressure transducers were placed near the lip of the gate. In addition, 14 accelerometers were attached at preselected locations on the gate. The second gate was instrumented with five accelerometers only for a limited data comparison. Data reduction indicated that many components vibrate at the same frequency as the gate lip pressure fluctuations. Computations and ring tests indicate that this frequency approaches at least one component's natural frequency. The gate seal at the lip was removed and the test repeated under identical conditions. The measured vibrations were all dramatically reduced. By varying the opening of the gates, under identical conditions, it was found that vibration severity decreased with increasing tailwater submergence. Remedial measures in design and operation of the gates were recommended. (WES).
W80-06540

DUAL SOLUTION OFFERED TO FLOOD CONTROL PROBLEMS.
Mono Pumps Africa (Pty) Ltd. (South Africa). Power and Plant in Southern Africa (Johannesburg), p 31, April 1979. 1 Fig.

Descriptors: *Flood control, *Pumps, *Turbines, Equipment, Industries, *South Africa, *Mining, Flood protection, Pump turbines, Drainage engineering, Pump testing, Hydraulic equipment, Water pumping, Dewatering, Flow, Mine water, Evaluation, Polymers, Viscosity.

The advantages of Mono Pumps' (South Africa) new locally-designed and manufactured borehole range of Pumps and the locally-made axial flow pump are discussed. The Mono Rotary Lobe pump and a metering pump range of the plunger or diaphragm variety, as well as a static in-line mixer exhibit low shear characteristics which are essential when handling various polymers. Mono's helical rotor pump has excellent suction lift capacities and it has self-priming. Flood control problems can be diminished by a pump arrangement where the electric motor drive is completely isolated from flood areas due to the pump element being driven by a hire shafting, supported by rubber bearings in the center of the rising main. A hopper feeds in the thick cement/water grouts or any viscous material. Mono Pumps strenuously test their pumps at its Sekenza works and maintains a large stock of all ranges of pumps to quickly fill orders. Virtually all pumping needs can be met by one of Mono's pumps from metering a flow rate of one milliliter per hour to the 900 millimeter axial flow turbine unit with flows of up to 4,100 liters per second. (Sidney-IPA)
W80-06720

8D. Soil Mechanics

PERMANENT EFFECTS OF ELEVATED TEMPERATURE ON THE HYDRAULICS AND STRENGTH PROPERTIES OF CLAY CONFINING LAYERS IN AQUIFER STORAGE OF THERMAL ENERGY,
Auburn Univ., AL. Dept. of Civil Engineering.
D. N. Cullen, R. K. Moore, and F. J. Molz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-222268, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Institute, Auburn University Completion Report, July 1980. 81 p, 20 Fig, 21 Tab, 16 Ref, 1 Append. OWRT-A-069-ALA (2).

Descriptors: *Hydraulic properties, *Clays, *Mechanical properties, *Temperature, *Effects, Physical properties, Stress, Aquifers, Aquifer management, Energy conservation, Kaolinite, Illite, Bentonite, Investigations, Soil temperature, Thermal stress, Engineering, Permeability, Rates, Hydraulic conductivity, Volume, Expansive clays, Expansive soils, Inorganic compounds, Laboratory tests, Surface sealing, Soil compaction, Soil physics, Water storage, Numerical analysis, Measurement.

An investigation of the permanent effects of temperature on the physical and engineering properties of Georgia kaolinite, Urbana illite, and bentonite soils, was carried out to gain information about their use as clay seals for the storage of heated water in subsurface aquifers. Samples of the soils were consolidated from a slurry and treated at temperatures of 20, 90 and 160 degrees C for twelve hours after which they were subjected to analysis by a constant rate of strain consolidometer. Hydraulic conductivity, volume compressibility, and the coefficient of consolidation were measured and the data were tested for linear and quadratic temperature effects. Some of the clay minerals did not exhibit a permanent change in hydraulic properties after heating and those minerals which were affected displayed swelling on heating. The data for the Urbana hydraulic conductivity of Urbana illite showed a quadratic temperature effect at 97.5% confidence level. The effect of temperature on the hydraulic conductivity of bentonite was also positive linear at a 90% confidence level and the temperature effect of volume compressibility of bentonite was also linear positive. Georgia kaolinite did not give any significant temperature-related changes. More research on clay soils is needed, but as an initial observation, clays of high plasticity tend to be more susceptible to elevated temperatures and therefore not suitable for sealing an aquifer. (Sidney-IPA)
W80-06509

EVALUATING THE EFFECTS OF EARTHQUAKES ON BURIED PIPELINES,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Civil Engineering.
L. R. L. Wang, and H. A. Cornell.
Journal of the American Water Works Association, Vol 72, No 4, p 201-207, April 1980. 3 Fig, 3 Tab, 11 Ref.

Descriptors: *Earthquake engineering, *Pipelines, *Design criteria, *Systems analysis, Engineering structures, Joints(Connections), Pipe foundations, Soil physics, Soil engineering, Soil stabilization, Earthquakes, Engineering geology, Seismic design, Seismic waves, Stress, Travel time, Faults(Geologic), Landslides, Movement, Evaluation, Structural design, Mathematical studies, Reliability, Safety factors, Structural analysis, Velocity, Stress analysis, Seismic waves.

The state-of-the-art for the design of water pipelines which will withstand earthquakes is reviewed. New analytical methods have been developed to determine strain, stress, and joint movements in pipelines and the physics of the soils which support the pipework. Two types of waves emanate from the earthquake epicenter: vertical movement and horizontal movement. By far the most strain is placed on pipelines which are parallel (radial) to the wave direction since they experience severe axial and bending strain. The amount of strain can be estimated using simple equations which relate strain to the velocity of ground movement and the pressure wave's propagation speed through the ground. If these parameters can be estimated from seismic data, a pipeline system can be designed which takes into account soil conditions, pipe ductility, joint movement, and ground acceleration. The seismic vulnerability of the Latham water district near Albany, New York, resulted in a selection of a 450-year design earthquake with a 0.21 g ground acceleration and a 20% probability that this acceleration would be exceeded. Existing systems can be checked for vulnerability by a review of the geology, soils, possible faults, and possible ground velocity of the area. Previous earthquakes have alerted designers to the danger of pipes which transverse fault zones. Seismic vulnerability can only be estimated at this time, but this is sufficient to allow for reasonable design expectations. (Sidney-IPA)
W80-06635

A HYBRID FINITE ELEMENT MODEL APPLIED TO UNSTEADY FLOW PROBLEMS,
New Orleans Univ., LA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W80-06901

A SIMPLE TECHNIQUE FOR THE ANALYSIS OF FREE SURFACE FLOW PROBLEMS,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Civil Engineering and Building Technology.
For primary bibliographic entry see Field 2G.
W80-06904

8E. Rock Mechanics and Geology

SHEARING FLOWS OF GRANULAR MATERIALS,
Sandia National Labs., Albuquerque, NM.
S. L. Passman, J. W. Nunziato, P. B. Bailey, and J. P. Thomas, Jr.
Journal of the Engineering Mechanics Division, American Society of Civil Engineers, Vol 106, No EM4, Proceedings Paper 15647, p 773-783, August 1980. 7 Fig, 16 Ref, 1 Append. DOE DE-AC04-76-DP00789

Descriptors: *Shear, *Boundary processes, *Flow, *Granules, *Rock mechanics, Sands, Theoretical analysis, Soil mechanics, Geologic control, Equations, Faults(Geologic), *Shearing flow, Shear tests, Parallel plates.

The authors studied the shearing flow behavior of granular materials, using a theory based on one proposed by Goodman and Cowin. Solutions to the equations of motion were presented for the problem of shear flow between two paralled plates. The results showed in some cases the narrow, dilatant shear zones observed experimentally and in certain geological processes. (Visocky-ISWS)
W80-06679

8I. Fisheries Engineering

SEA-RUN RAINBOW TROUT OF THE EERSTE RIVER,
A. C. Harrison.
Piscator (Cape Town), No 103, p 68-76, 1978. 1 Fig.

Descriptors: *Rainbow trout, *Fish migration, *Sea water, *South Africa, Rivers, Fish, Freshwater fish, Fish physiology, Environmental effects, Foods, Sands, Estuaries, Flavor, Movement, Coasts, Evaluation, Frequency.

The rainbow trout of the Eerste River, South Africa, have long been suspected of feeding in salt water and the evidence to support this view is presented. The Eerste is the only river in the southern area of South Africa which has the sandy bottom and conditions suitable for the silvery coastal type of rainbows. Three rainbows have been caught and identified in the estuary area of the Eerste River and some were found to contain mullets in their stomachs indicating feeding in salt water. The fish were silvery and the flesh was salmon-pink and of sea-trout flavor. All three specimens had teeth which appeared to be unusually long and curved, due to loss of fat from the process of acclimation from fresh to salt water. It is not known if the movement of the coastal rainbows is a general phenomemon or merely the movement of individuals. (Sidney-IPA)
W80-06719

AQUACULTURE: A MODERN FISH TALE, SEMINAR CONDUCTED BY WATER RESOURCES RESEARCH INSTITUTE, OREGON STATE UNIVERSITY, SPRING QUARTER 1979.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-105348, Price codes: A05 in paper copy, A01 in microfiche. Oregon State University, Corvallis, Water Resources Research Institute Report, July 1979. 91 p, 16 Fig, 13 Tab, 47 Ref. OWRT-A-999-ORE (25).

Descriptors: *Aquiculture, *Aquatic productivity, *Fish farming, *Fisheries, *Economic feasibility, *Oregon, Hatching, Salmon, Fish diseases, Economics, Management, Pacific Northwest U.S., Technology, Harvesting, Regulation, Productivity, Greenhouses, Solar energy, Water temperature, Filters, Foods, Water rights, Shores, Marketing, Filtration, Federal Government, State governments, Washington, Michigan, Oysters, Trout, Oxygen demand, Water supply, Stocking, Hunting, Channel catfish.

This report is a compilation of weekly seminars presented to scientists, practicing water resource specialists, students, and the general public on fish farming and ocean ranching status, developmental prospects, and problems. The topics covered were: prospects for aquiculture; State/Federal activities in aquiculture; Oregon salmon ranching; fish health management; engineering technology in oyster/salmon production; channel catfish production in geothermal water; aquiculture in a solar greenhouse; and economic issues. Facilities, Oregon State programs, and collaborative programs are discussed. The more technical seminars included salmonid diseases (viral/bacterial/protozoan/fungal), channel catfish production using concrete facilities, and solar greenhouse production for mirror carp and tilapia at Eugene, Oregon. Production rates and operating economics are included topics in several of the seminars. Intensive fish culture has come into focus in the United States only within the last two decades. Present constraints to aquiculture appear to be more political and administrative than scientific and technological. This seminar series is one of the activities regularly undertaken by the Water Resources Research Institute to facilitate water resources and education for the State of Oregon on aspects of quality and quantity of water available for public benefit. (See W80-06724 thru W80-06731) (Zielinski-IPA)
W80-06723

WHAT ARE THE PROSPECTS FOR AQUACULTURE,
Oregon Aqua-Foods, Inc., Springfield.
W. J. McNeil.
In: Aquaculture: A Modern Fish Tale, Seminar Conducted by Water Resources Research Institute, Oregon State University, Spring Quarter 1979, p 1-6, July 1979.

Descriptors: *Aquiculture, *Aquatic productivity, *Fish farming, *Foods, Hunting, Water rights, Economics, Productivity, Biomass, Coasts, Ponds, Lagoons, Oceans, Aquatic populations, Fisheries.

Aquatic food production is discussed, with special emphasis on aquatic farming prospects. Brief commentaries are given to questions on aquatic food quantity, aquatic hunting limitations, hunting rights reallocation benefits, hunting to farming transition, economic potential of aquiculture, promising aquiculture types, aquiculture barriers, and the poten-

tial for aquiculture in the United States. Using a simple model, it is argued that less than 1% of the global harvestable organism biomass is in aquatic environments; that the practical limit to aquatic foods by traditional hunting techniques will increase only slightly, up to about 70 million tons; that it is presently not known whether major reallocation of coastal/world hunting rights will significantly increase productivity of wild stocks; that aquatic farming grew from about 2% to 10% of the total world aquatic food supply over the 1962-1977 period; that aquiculture will contribute less than one-half of the maximum aquatic food production; that crustacean/fish culture (ponds/lagoons), molluscan culture (coastal waters), and anadromous fish ranching (oceans) are the most promising types of aquiculture; that scientific, technical, political, and economic problems need addressing; and that aquiculture will show a steady but modest growth in the United States. (See also W80-06723) (Zielinski-IPA)
W80-06724

STATE AND FEDERAL ACTIVITIES IN AQUACULTURE,
Oregon Dept. of Fish and Wildlife, Portland.
E. R. Jeffries.
In: Aquaculture: A Modern Fish Tale, Seminar Conducted by Water Resources Research Institute, Oregon State University, Spring Quarter 1979, p 7-11, July 1979.

Descriptors: *Aquiculture, *Aquatic productivity, *Fisheries, *Hatching, *Fish farming, Oregon, Washington, Productivity, Michigan, Great Lakes, Salmon, Fish diseases, Economics, Federal Government, State Governments.

The Fish Culture program of the Oregon Department of Fish and Wildlife (ODFW) is discussed including a brief outline of Federal supported activities. ODFW completed construction for new facilities at Bonneville Hatchery, and is completing two other hatcheries (on the Clackamas and on Rock Creek). Fish culture was about 30% of the total agency budget ($47 million) for two years in the 1979-81 period. Cooperative programs of ODFW exist with Oregon State University in nutrition research and fish diseases. Two pellet food manufacturers provide ODFW, the Washington Department of Fisheries and other agencies with over 20 million lbs/year at a cost of $0.315/lb. ODFW provided the first million coho eggs to Michigan for Great Lakes stocking for sport fishing and for control of alewifes. Operation of a salmon hatchery, harvesting, and sale (about 35 million fall chinook eggs were taken at Bonneville in 1978) are discussed. Authorized permits cover release of 37.8 million coho, 42 million chinook, and 100.5 million chum salmon. (See also W80-06723) (Zielinski-IPA)
W80-06725

SALMON RANCHING IN OREGON,
Oregon State Univ., Newport. Marine Science Center.
J. E. Lannan.
In: Aquaculture: A Modern Fish Tale, Seminar Conducted by Water Resources Research Institute, Oregon State University, Spring Quarter 1979, p 13-14, July 1979.

Descriptors: *Aquiculture, *Aquatic productivity, *Fish farming, *Salmon, *Hatching, *Oregon, Fisheries, Foods, Management, Economics, Trout.

A brief summary is presented of an article published earlier in Salmon Ranching (Academic Press, J. Thorpe (Editor), 1979). Salmon ranching in Oregon denotes the extensive production of salmonid fishes (including chinook, coho, and chum salmon, and steelhead/anadromous rainbow trout), used as a management strategy to supplement naturally reproducing stocks. The State operates 32 public salmon/trout hatcheries; Federal Government operates one. Oregon statutes authorize regulated private ranching for chum, coho, chinook, and pink salmon, but not steelhead. Fish released from private production facilities become a common property resource. When private salmon producers attain their authorized capacities, they will contribute an equivalent number of adult salmon to Oregon's fisheries without public fund expenditures, thus providing a substantial benefit to the State from private sector ranching. It seems unlikely that Oregon salmon ranching will increase significantly beyond the presently authorized production levels in the foreseeable future. (See also W80-06723) (Zielinski-IPA)
W80-06726

FISH HEALTH MANAGEMENT IN AQUACULTURE,
Oregon State Univ., Corvallis. Dept. of Microbiology.
J. S. Rohovec, and J. L. Fryer.
In: Aquaculture: A Modern Fish Tale, Seminar Conducted by Water Resources Research Institute, Oregon State University, Spring Quarter 1979, p 15-35, July 1979. 3 Fig, 2 Tab, 30 Ref.

Descriptors: *Aquiculture, *Fish diseases, *Viruses, *Fungi, *Bacteria, *Protozoa, *Microbiology, Aquatic productivity, Fisheries, Hatching, Oregon, Fish farming.

Pacific Northwest salmonid infectious agents and methods for their control are discussed. The infectious agents, or pathogens, include viral (infectious pancreatic necrosis virus; infectious hematopoietic necrosis virus; piscine erythrocytic necrosis virus; and herpesvirus salmonus), bacterial (Aeromonas salmonicida; Corynebacterium salmoninus; Vibrio anguillarum; Yersinia ruckeri; Flexibacter columnaris; Cytophaga psychrophila; bacterial gill disease; Aeromonas hydrophila; Lactobacillus sp.; and Mycobacterium sp.), protozoan (Ceratomyxa shasta and Myxobolus insidiosis), and fungal (Saprolegnia parasitica and Phoma herbarum) agents. The control of pathogens can be accomplished by using several techniques. In the hatchery, ponds, equipment, and eggs should be disinfected, and water supplies should come from pathogen-free wells or springs whenever possible. Where this is not feasible, the water supply should be free of wild fish which can act as reservoirs of infectious agents. Strict sanitation methods are required and with the use of knowledge concerning disease causing agents, and proper management techniques, the incidence and severity of fish diseases in the Pacific Northwest can be reduced. The pathogens, the disease they cause and possible control methods are listed in a table. (See also W80-06723) (Zielinski-IPA)
W80-06727

ENGINEERING TECHNOLOGY IN PRODUCTION OF OYSTERS AND SALMON,
Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
M. English, and E. Kolbe.
In: Aquaculture: A Modern Fish Tale, Seminar Conducted by Water Resources Research Institute, Oregon State University, Spring Quarter 1979, p 37-53, July 1979. 4 Tab, 3 Ref.

Descriptors: *Aquiculture, *Engineering, *Pacific Northwest U.S., *Oysters, *Salmon, *Fish farming, Economics, Fish diseases, Regulation, Productivity, Technology, Hatching.

An examination of the state of engineering technology in the Pacific Northwest salmon and oyster industries is presented. Barriers to increased productivity or economic efficiency in the areas of economics/marketing, biology, nutrition, disease control, environmental/institutional regulations, and engineering (e.g., aquiculture facility design) are identified. Discussion of the oyster industry covers current technology, seed availability, existing systems, new growing areas, pollution, financing, out-bay culture, and concludes that engineering design/development needs lie in (1) improving marginal operations, (2) addressing environmental/institutional restrictions, and (3) new/efficient technology applications to oyster rearing. In discussing salmon ranching, the role of engineers in hatchery operations, salmon release, recapture and breeding, and processing are covered. (See also W80-06723) (Zielinski-IPA)
W80-06728

CHANNEL CATFISH PRODUCTION IN GEOTHERMAL WATER,
Fish Breeders of Idaho, Buhl.
L. Ray.
In: Aquaculture: A Modern Fish Tale, Seminar Conducted by Water Resources Research Institute, Oregon State University, Spring Quarter 1979, p 55-59, July 1979.

Descriptors: *Channel catfish, *Aquiculture, *Geothermal studies, *Aquatic productivity, Concrete-lined canals, Fish farming, Facilities, Fish diseases, Oxygen demand, Ammonia, Management, Stocking, Water supply.

Channel catfish (Ictalurus puntatus) have been raised in geothermal facilities for six years, affording superior product to other market catfish. The use of concrete facilities and 6,000 gallons/minute of water permit densities of 5-10 lbs/cu ft of space and 10,000 lbs/second ft of water. Oxygen and ammonia are the principal factors controlling production, and disease is a related factor. The main factors limiting geothermal fish farming expansion lie in identifying the resource, facility design, financing, construction, production, processing, marketing, and distribution. These factors are separately considered. Facilities, water supply, and stocking rate topics are also discussed. (See also W80-06723) (Zielinski-IPA)
W80-06729

AQUACULTURE IN A SOLAR GREENHOUSE,
Amity Foundation, Springfield, OR.
W. Head.
In: Aquaculture: A Modern Fish Tale, Seminar Conducted by Water Resources Research Institute, Oregon State University, Spring Quarter 1979, p 61-76, July 1979. 8 Fig, 7 Tab, 6 Ref.

Descriptors: *Aquiculture, *Aquatic productivity, *Water quality, *Facilities, *Greenhouses, *Filtration, Solar energy, Water temperature, Filters, Fish farming, Harvesting, Foods.

A 350 ft solar greenhouse constructed in Eugene, Oregon, was used to test two methods for growing fish in water heat storage tanks (trickling filter tank and air-lift filter tank). Fish were raised in the two 1700-gallon concrete tanks with water quality controlled by windmill aeration and biological filtration. The mean monthly water temperature in the tanks (June 1978-July 1979) ranged from 84-67 F, while the mean monthly greenhouse air temperature ranged from 89-72 F. Fish raised were the mirror carp and two tilapia species. Seven harvests from each tank yielded a total of 167 lbs, 9 oz, with 25% additional lbs of fish harvested from the trickling filter tank than from the air-lift tank. It is concluded that (1) edible fish can be productively raised by this system, (2) water quality provides rapid fish growth and good fish flavor, and (3) fish grow best in mid 80's F water temperatures. (See also W80-06723) (Zielinski-IPA)
W80-06730

SOME ECONOMIC ISSUES IN AQUACULTURE,
Oregon State Univ., Corvallis. Dept. of Agricultural and Resource Economics.
R. S. Johnston.
In: Aquaculture: A Modern Fish Tale, Seminar Conducted by Water Resources Research Institute, Oregon State University, Spring Quarter 1979, p 77-91, July 1979. 5 Fig, 8 Ref.

Descriptors: *Aquiculture, *Aquatic productivity, *Fish farming, *Economic feasibility, Water rights, Shores, Foods, Salmon, Marketing, Economics, United States, Water rights, Productivity.

Three topics are discussed, covering current interest in aquiculture (especially in the United States), why this interest did not emerge earlier, and differences between economic feasibility/success of an aquicultural firm and the economic feasibility of an aquicultural industry. The first topic is discussed under categories of nutritional demand, technological changes, and the strength of property rights. It is felt that a factor explaining the early lack of interest in aquiculture in the United States relative

to foreign countries has been the strong competition for shoreline space with commercial/sport fishing and recreation, mineral exploration, and waste disposal. Discussion of the economics relative to the private firm and the market covers salmon aquiculture and consumer demand, sockeye salmon demands facing wholesalers and processors, and market structure considerations. (See also W80-06723) (Zielinski-IPA)
W80-06731

THE HABITATS AND HABITAT PREFERENCES OF CLARIAS GARIEPINUS (PISCES: CLARIIDAE) IN A CLEAR COASTAL LAKE (LAKE SIBAYA, SOUTH AFRICA),
J. L. B. Smith Inst. of Ichthyology, Grahamstown (South Africa).
M. N. Bruton.
Journal of the Limnological Society of Southern Africa (Bloemfontein), Vol 4, No 2, p 81-88, 1978. 6 Fig, 3 Tab, 23 Ref.

Descriptors: *Sharptooth catfish, *Aquatic habitats, *Growth stages, *Habitat preference, *Catfishes, Larval growth stage, Juvenile growth stage, Mature growth stage, Lakes, Lake shores, Profundal zones, Shallow water, Freshwater, Rooted aquatic plants, *South Africa, Diel migration, Collection methods, Nets, Fish traps, Pools.

The habitat preferences of four growth stages of the sharptooth catfish, Clarias gariepinus, in a clear coastal South African lake, Lake Sibaya, are described. Larval and small juvenile catfish were found in the root-stocks of semi-aquatic plants, and in flotsam on the lake edge and on the floor of marginal pools. Larger juveniles occupy marginal pools that are densely vegetated, and may enter open areas at night. Most of the adult catfish inhabit deeper terrace waters, sheltered bays, and slopes and profundal areas. During the night they undergo a diel migration into shallower waters. Because the habitats of the sharptooth catfish range from deep profundal habitats to shallow littoral areas, a variety of collection methods were used. The methods employed were: handnets and fonya baskets; fishtraps; fixed lines and longlines; gill nets; rod and lines; and seine and trawl nets. A description of Lake Sibaya includes the seven main habitats. (Stiles-IPA)
W80-06736

10. SCIENTIFIC AND TECHNICAL INFORMATION

10A. Acquisition And Processing

WATER QUALITY INDEXING AND SCORING,
Weston (Roy F.), Inc., West Chester, PA.
For primary bibliographic entry see Field 6B.
W80-06756

10C. Secondary Publication And Distribution

CALIFORNIA WATER RESOURCES CENTER: CHRONICLE OF RESEARCH, 1957-1980,
California Univ., Davis. Water Resources Center.
J. H. Snyder.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-222276, Price codes: A08 in paper copy, A01 in microfiche. Report No 48, June 1980. 148 p. OWRT-A-999-CAL (16).

Descriptors: *Projects, *Research and development, *Research priorities, *Project planning, Evaluation, Allotments, Grants, Contracts, Water utilization, Reviews, Information retrieval, Bibliographies, *California.

This publication contains individual reports on projects funded by the Water Resources Center between 1957 and 1980. The projects are grouped according to the research program categories of the Center. A short statement introduces each category and describes the nature of the research work. Because of the Center policy to supplement and fill in gaps in research activity wherever possible, there is considerable variation in the amount of research conducted in each category. The project title, names and departments of principal investigators, the Center research identification number and the starting and ending dates are listed for each project. A parenthetic indication to identify its source of funds as 'State', 'Federal', or a combination, 'Federal/State', is also shown. A brief narrative report emphasizes, where possible, the 'hard' results of the research. This is followed by a list of publications resulting from the Center-sponsored project.
W80-06453

GLACIOLOGICAL DATA: SNOW COVER.
Colorado Univ. at Boulder. Inst. of Arctic and Alpine Research.
For primary bibliographic entry see Field 2C.
W80-06474

10F. Preparation Of Reviews

BOUNDARY METHODS IN WATER RESOURCES,
Universidad Nacional Autonoma de Mexico, Mexico City.
For primary bibliographic entry see Field 2E.
W80-06862

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